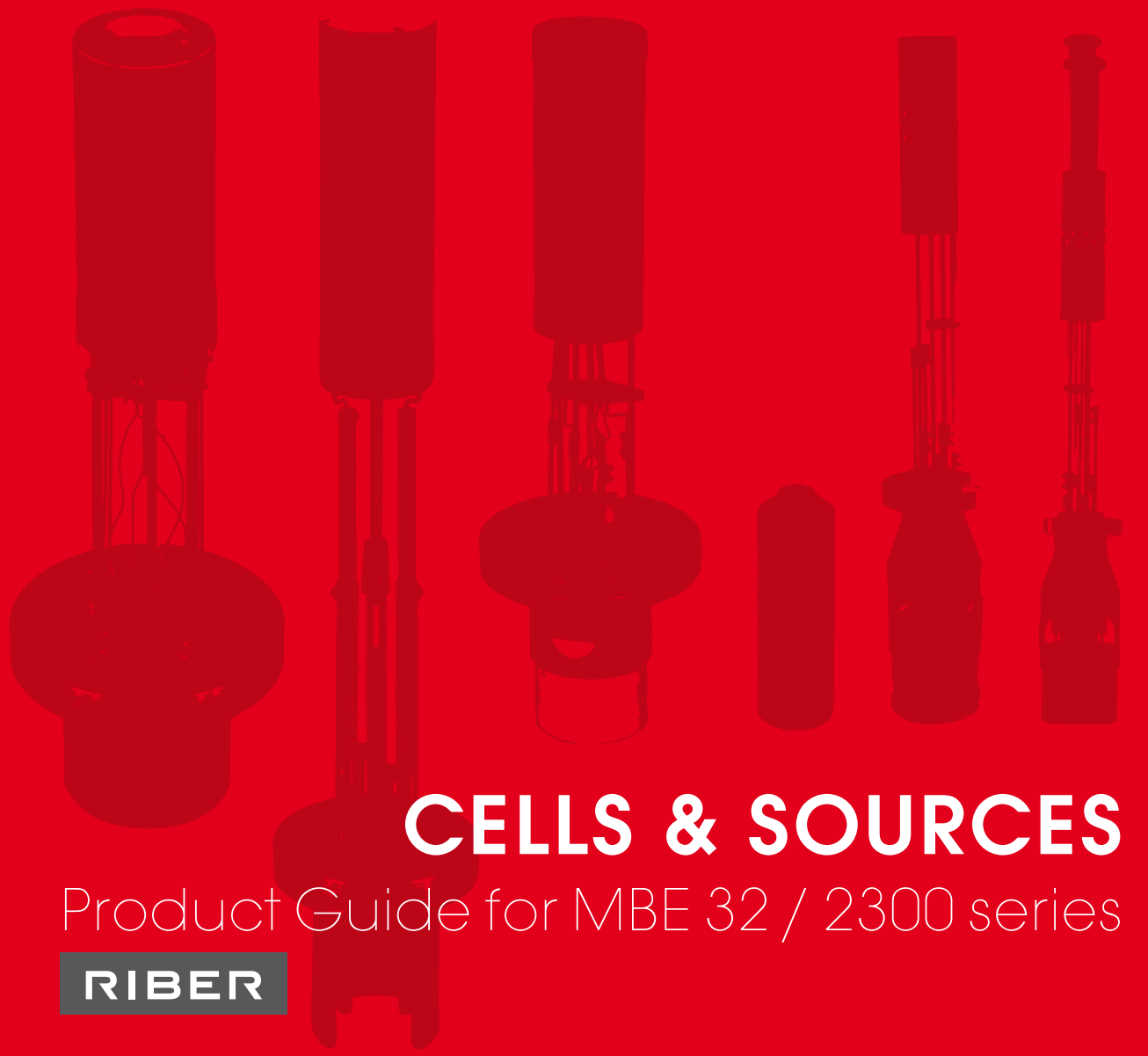
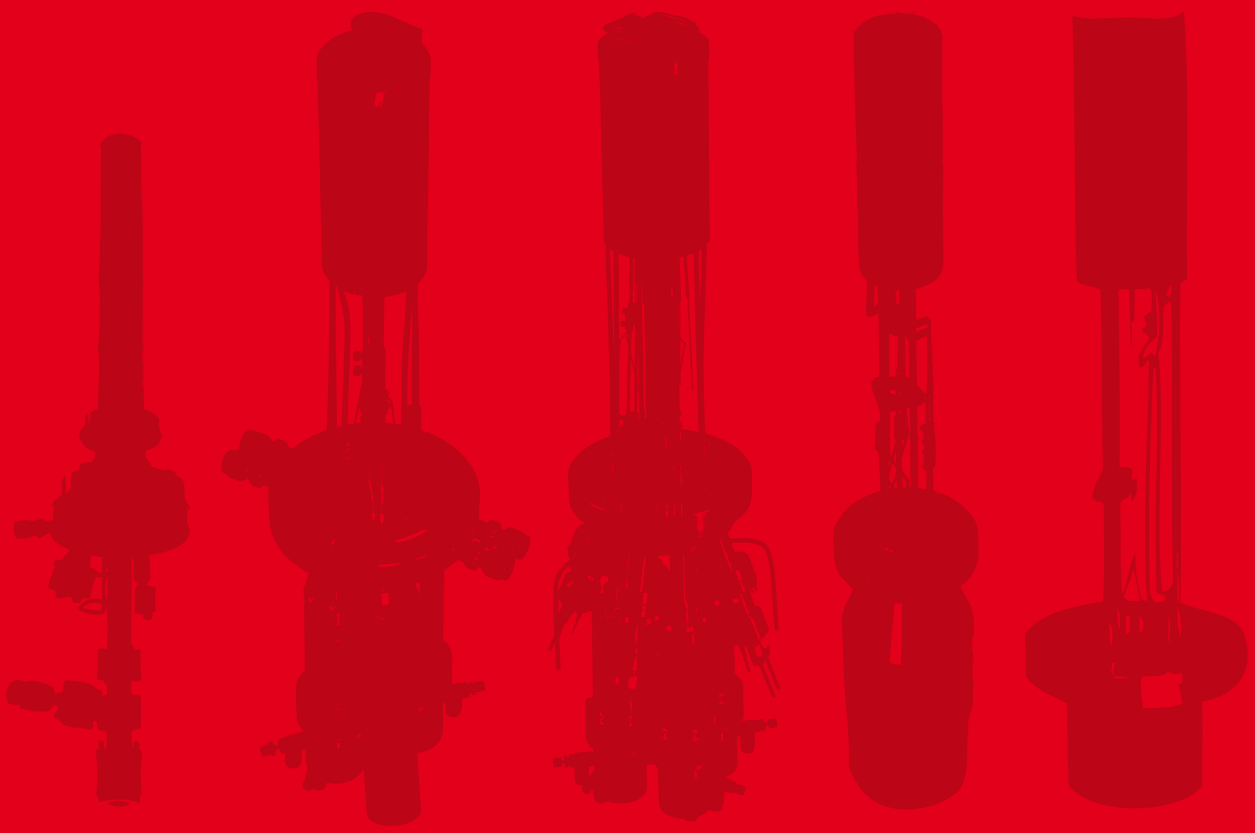


CELLS & SOURCES

Product Guide for MBE 32 / 2300 series

RIBER



More than any other component, cells and sources are key to the quality of materials grown by MBE (i.e. morphology, purity, composition, uniformity, etc.). With over 10 500 MBE sources in the field, Riber has the largest installed base. Our experience in high-quality components and years of close cooperation with leading research and production groups has brought Riber to the forefront of MBE source technology.

This product guide, presents Riber comprehensive range of effusion cells and sources designed specifically for your MBE 32 / 2300 system. Thanks to our experience, reliability and quality, Riber all effusion cells and sources provide pure, stable and reproducible beam fluxes of elemental species.

Moreover, our ongoing developed programs allow us to continuously meet the needs of the compound semiconductor community and provide you with specific source materials.

Thank you for your continued support, and we look forward to working with you.

Riber

LARGEST RANGE OF BEAM GENERATOR FOR MBE

Effusion cells

Riber workhorse product used on MBE systems is the effusion cell or sometimes called K-cell. Each effusion cell includes an oven (filament + thermocouple) and fully degassed crucible, surrounded by tantalum shielding for use in proximity of a cryoshroud. The preferred crucible material is PBN, although other materials are employed, notably ultrapure graphite for high temperature evaporation and quartz for temperature below 500°C. Crucibles are designed to provide a very stable flux during charge depletion. The heating filament is made of high purity tantalum foil. Effusion cells design have an operating temperature range up to 1200°C, which makes outgassing sequences at 1400°C. Conventional temperature control based on PID controllers and thermocouple feedback are employed to provide stable temperature control. The source mounting flange houses power and thermocouple feedthroughs.

Valved cracker cells for As, P, Sb

Cracker cells are modified version of effusion cells. Beams are directed via a high temperature cracker tube onto the surface. These sources are used for group V materials. The cracker tube provides at elevated temperature multi-collision path for the beams and dissociates the molecules. The temperature for 100% dissociation is typically between 800 - 1000°C.

Plasma sources and valved plasma sources

To efficiently incorporate Nitrogen, Oxygen, Hydrogen into the lattice, creation of more reactive forms are needed. The most successful method for obtaining reactive species is the use of RF plasma source. Dissociated atomic and molecular radicals are generated in the plasma and flow through the end piece having an own pattern specifically designed for the system towards the substrate. Many parameters control the plasma including the RF power, the gas flow rate, the number, size and configuration of the front cover plate. To optimize and maximise the generation of species, Riber provides the solution of a valved RF plasma source for mixed nitride were it is crucial to adjust precisely the end flow.

Gas injectors

Riber worldwide famous injectors with integrated run/vent valves are key to process control in CBE and GSMBE MBE 32 / 2300 systems. Gas injectors are valved and regulated by mass flow controllers or pressure regulators. Injectors focus gas molecules through collision with a directional plate. Precise control of the beam using fast acting gas line valve is translated into precise control of the species arriving at the substrate surface. Gas supply to UVH reactors include the injector, heating and beam control.

CELLS & SOURCES

for MBE 32 / 2300 series Research System

SOURCE SELECTION GUIDE

Material	Temperature (°C) at vapour pressure (Torr)			Recommended source	Page number
	10^{-8}	10^{-6}	10^{-4}		
Ag	574	685	832	Medium temperature effusion source	47
Al	685	812	972	Medium temperature effusion source	47
Ammonia				Ammonia Module Gas injector	16 20
As	104	150	972	Valved cracker source for Arsenic Low temperature effusion source	31 40
Au	807	947	1132	High temperature source	52
B	1282	1467	1707	Dopant source High temperature source	56 52
Ba	272	354	462	Low temperature effusion source	40
BaF2	729	840	984	Medium temperature effusion source	47
Be	707	832	997	Dopant source	56
Bi	329	409	517	Low temperature effusion source	40
C	1657	1867	2136	Carbon dopant source CBr4 module Gas injector	58 18 20
CaF2	817	938	1094	Medium temperature effusion source	47
Cd	74	119	177	Low temperature effusion source	40
Cds	367	448	555	Low temperature effusion source	40
CdSe	359	438	543	Low temperature effusion source	40
CdTe	290	362	455	Low temperature effusion source Valved corrosive source	40 37
Co	922	1067	1257	High temperature source	52
Cr	837	977	1157	High temperature source	52
Cu	722	852	1027	Medium temperature effusion source	47
Dy	625	747	897	Medium temperature effusion source	47
Er	649	777	897	Medium temperature effusion source	47
Eu	283	361	466	Low temperature effusion source	40
Fe	858	998	1180	High temperature source	52
Ga	619	742	907	MS source Medium temperature effusion source	44 47
Ge	812	947	1137	Dopant cell Medium temperature effusion source	56 47
H				RF plasma source Valved RF plasma source	10 13
Hg	72	- 44	7	Mercury source	23
In	488	597	742	MS source Medium temperature effusion source	44 47
K	21	65	123	Low temperature effusion source Source for Alcaline	40 26

La	990	1212	1388	High temperature source	52
Li	235	306	404	Low temperature effusion source Source for Alcaline	40 26
Lu	870	1228	1376	High temperature source	52
Mg	185	246	327	DZ MM Valve corrosive source Low temperature effusion source	28 37 40
Mn	505	611	747	Low temperature effusion source	40
N				RF plasma source Valved RF plasma source	10 13
Na	74	123	193	Low temperature effusion source Source for Alcaline	40 26
Ni	927	1072	1262	High temperature source	52
O				RF plasma source Valved RF plasma source	10 13
P	54	88	129	Valved cracker source	34
PbSe	346	420	514	Low temperature effusion source	40
PbTe	339	413	508	Low temperature effusion source	40
Pd	842	992	1192	High temperature source	52
Pt	1292	1492	1747	High temperature source	52
S	- 10	17	55	Valved corrosive source	37
Sb	279	345	425	Valved corrosive source Low temperature effusion source	37 40
Se	63	107	164	Valved corrosive source	37
Si	992	1147	1337	Dopant source	56
Sn	682	807	997	Dopant source	56
SnTe	314	384	473	Dopant source	56
Sr	241	309	404	Low temperature effusion source	40
Te	155	209	280	Valved corrosive source	37
V	1162	1332	1547	High temperature source	52
Yb	247	317	417	Low temperature effusion source	40
Zn	123	177	247	DZ MM source Low temperature effusion source	28 40
ZnTe	361	439	540	Low temperature effusion source	40

Please note that because we strive to permanently improve the quality of our products and services, the data given in this catalog may vary without notice.

SPECIALITY SOURCES

RF plasma source
for Nitrogen / Oxygen / Hydrogen / Solid Materials

Valved RF Plasma Source
for Nitrogen and other gases

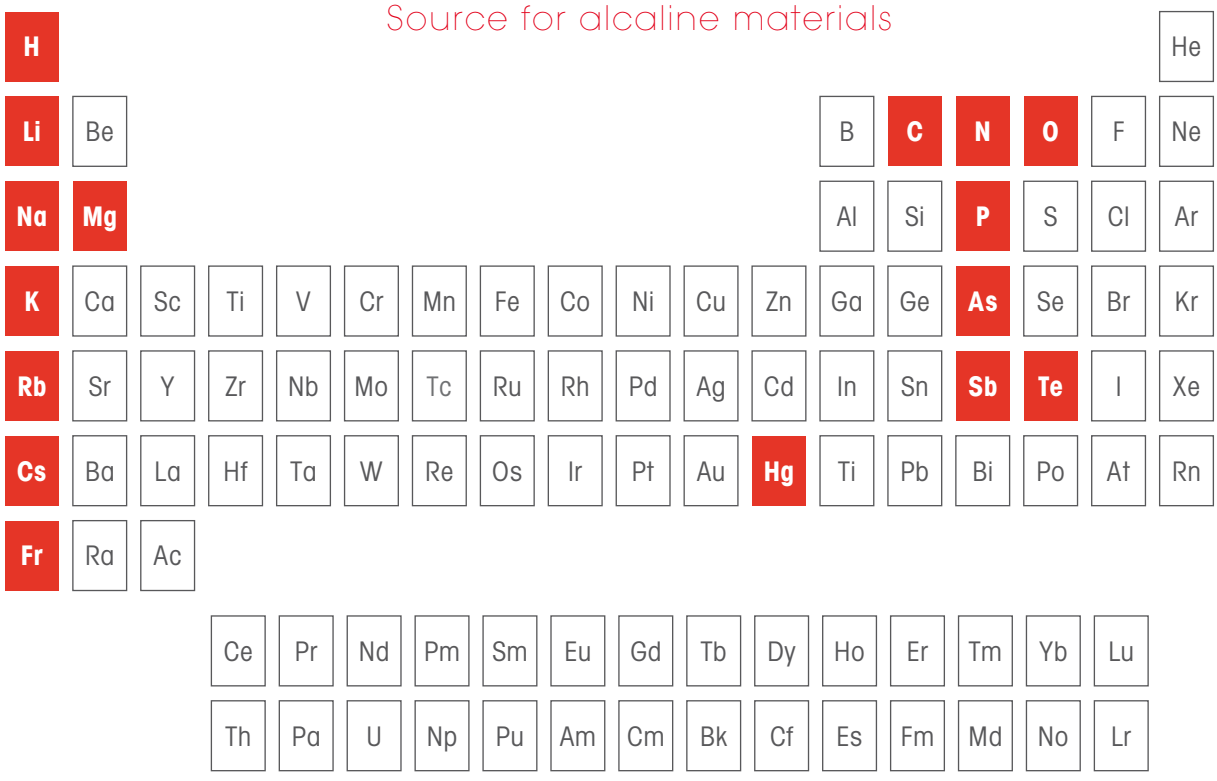
Ammonia Module

CBr4 Module

Gas Injector

Mercury source

Source for alcaline materials



SPECIALITY SOURCES

RF plasma source for Nitrogen / Oxygen / Hydrogen / Solid Materials

- **More than 80 sources worldwide**
- **Largest range of models from research to production**
- **High Atomic species production**
- **Perfect for spintronics, high k applications**
- **Perfect for MgZnO, and related oxides for future electronic**
- **Perfect for GaN based LED and power amplifiers**
- **Low gas consumption**
- **Efficient and reliable design**

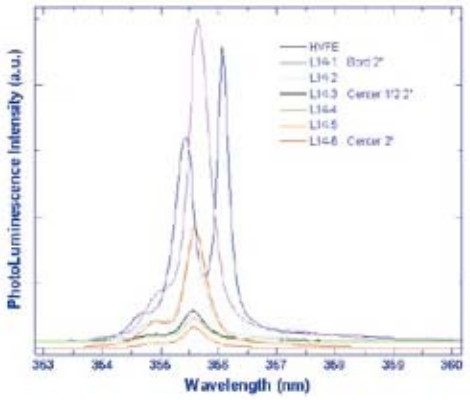
Riber offers the largest range of RF sources on the market today. RF sources cover the needs from research to production customers. Different materials for the discharge cavity are available to configure the source for atomic Nitrogen, Oxygen or Hydrogen or solid materials. RF sources cover a large field of applications such as Nitrides (GaInAlN…), diluted nitride (GaInAsN, II-VI doping), Oxides (ZnO, spintronics, high-K…), diluted Oxides (Doping, mixted Nitride / Oxide) and in situ hydrogen surface cleaning.

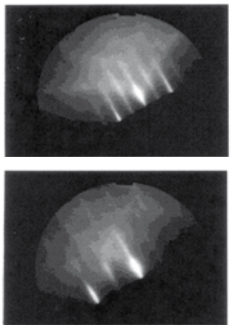
The minimum source configuration requires a cavity, a cell body, and a matching box (comprising RF generator; cable and water switch). A manual leak valve is supported in option for direct installation of the gas bottle. Semiconductor grade gas panels are available for Mass flow control and gas purifier, as well as the driving electronics. With the use of the gas panel the leak valve becomes an isolation valve.

Working principles

The RF plasma source operates by mean of an electrical field produced by the inductive coupling of the RF coil surrounding the cavity. A RF (13.56 MHz) generator delivers power to the discharge cavity space. To maximize power transfer to the plasma, a matching network is used to match the 50 Ohm impedance of the generator to the purely 50 Ohm impedance of the cavity load. Plasma in the cavity space produces atoms by dissociation of the molecular species. Atoms flow along with the non-dissociated molecules into the vacuum environment through an array of small holes at the front disk of the cavity («end – plate»).The hole arrangement is also called «pattern». This pattern depends on source application. A large flux will require a large number of holes compared to an application where only a very small flux is required. Atoms have generally a very low recombination coefficient, so even those undergoing through several wall collisions will ultimately contribute to the atom beam flux. The electron sheet, covering the cavity inside walls, the holes size and shape are designed to minimize ions and electron release from the cavity (Current lower then 10 nA / cm2). Gas breakdown will occur above a certain pressure in the cavity. This pressure depends of the gas ionization potential. In consequence, and for a given cavity pattern the flow rate of molecular gas will vary from gas to gas.

Results





GaN(2x2) RHEED pattern

Photoluminescence of GaN on Al_2O_3 obtained with the RF- N-600 on a Riber system. The growth is performed at 780°C with a Nitrogen flow rate of 0.65 sccm achieving a deposition rate of 0.4µm/h. FWHM of 4meV is obtained.

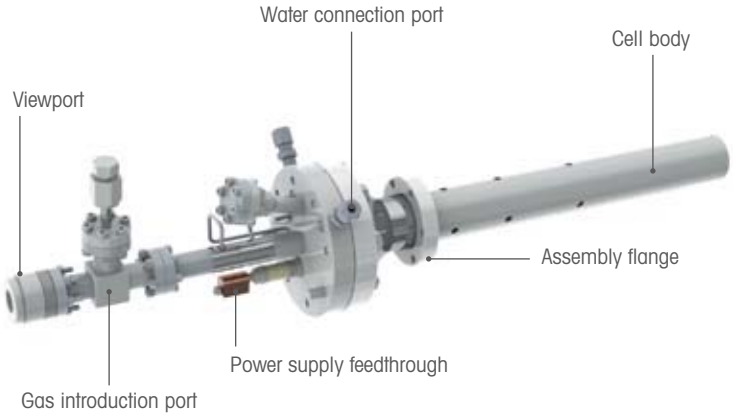
Product guide

Source model :
X stands for
N : nitrogen
O : oxygen
H : hydrogen

Size flange

RFX 450 40

Generator Power (w)



Specifications

Specifications		RF-X-450 40
Cavity	Material	PBN (N2/H2) or Quartz (O2/H2)
	Type	One piece
Generator	tuning unit	Automatic - Manual version also available
	Power supply	450 W
Plasma oberservation	Viewport	CF 16
Water cooling		Available
Gas inlet		CF 16
Options	Plasma light emission detection	Available
	Manual leak valve	Available
	Gas panel + mass flow controller + controller	Available
	Gas purifier panel	Available

Cavity product guide

Model : CAV : cavity

Material : QTZ : quartz
PNB

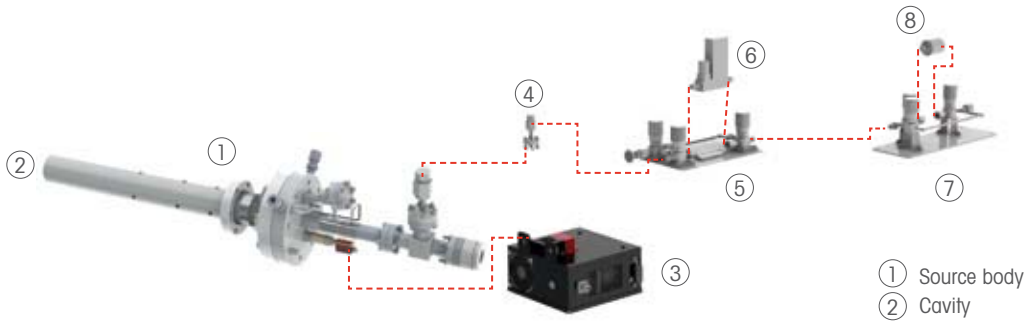
Pattern

CAV | QTZ | 149

Ordering information

Gas element	Model	Reference	Cavity model	Reference
N2 / O2 / H2	RF-X 450 40	R 235 049 90 G	CAV QTZ 149 CAV PBN 149	R 330 007 60 Z R 330 071 50 V

With the use of Nitrogen gas, Riber recommends a PBN cavity
With the use of Oxygen gas, Riber recommends a Quartz cavity

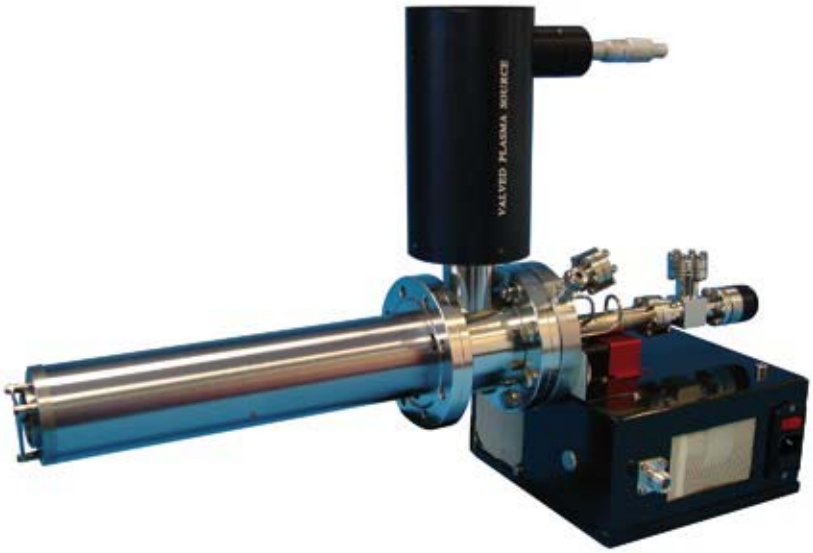


Additional accessories

Item	Equipment	Model	Description	Reference
3	RF Manual matching box	MMB	Manual RF tuning unit with cooling fan and cable Water flow meter and water switch for generator interlock	R 235 046 00 L
3	Automatic Impedance Matcher	AIM	Automatic impedance matcher box with cable Driving electronics Water flow meter and water switch for generator interlock	R 235 046 10 X
4	Leak valve	LKV	All metal leak valve	R 637 450 20 Y
5	MFC gas panel	MFCGP	Mass flow gas panel Pumping line to vent entrance allows purge of the high/low pressure stage. Mass flow not included	R 241 162 40 M
6	Mass flow	MFC N MFC O MFC H MFC Ar	0 - 10 sccm	R 626 700 30 F R 626 700 31 G R 626 700 32 H R 626 700 33 J
7	Gas purifier panel	GPP	By pass assembly for purifier equipped with two-3 ways manual valve. Purifier not included	R 630 810 00 M
8	Purifier	PURIF N2/Ar PURIF O2 PURIF H2		R 630 810 10 Y Consult Riber R 630 810 20 J
-	Mass flow controller	MFC rack	Digitable rackable 19" MFC Controller and cable	R 235 046 30 U
		MFC Top	Digital table top MFC Controller and cable	R 235 046 40 E
-	Plasma light detector	ED-FI	Optical detection filter / Low noise amplification of the atomic peak	R 235 030 50 B
-	Ion deflection plates	IDP 60	Table top DC power supply	Consult Riber

SPECIALITY SOURCES

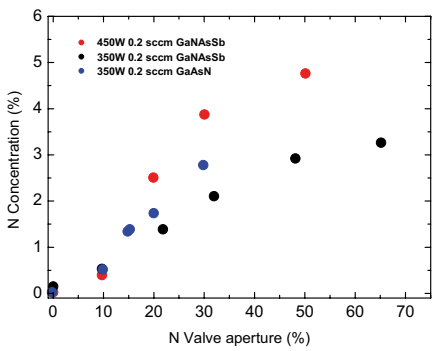
Valved RF Plasma Source for Nitrogen and other gases



- **Patented design providing rapid changes from 0 to 10% in 1 sec**
- **Reproducible production of reactive species**
- **Achieves high uniformity profiles**
- **Ideal design for dilute nitride applications**
- **Ready to use source with no plasma stabilization time**

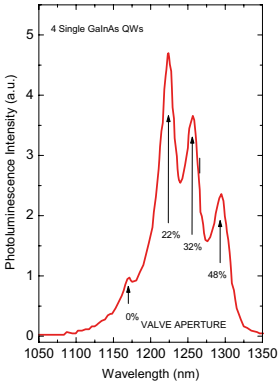
Riber Valved RF plasma source delivers the same technical features as valved cracker cells. Hence great flexibility over the control of the flux of reactive species is ensured. Valved in close position retains the same working conditions leaving the source ready to use without any plasma stabilisation time contrary to the use of standard RF plasma source.
Riber valved RF source unique patented design transforms the flux emitted by a standard RF source to something like a gas of reactive species, giving unsurpassed flux uniformity over wafers.
Valve RF plasma source is able to deliver the few sccm of flux necessary for dilute applications, resulting in a lower operating pressure in the system, providing better process controlled conditions.

Results



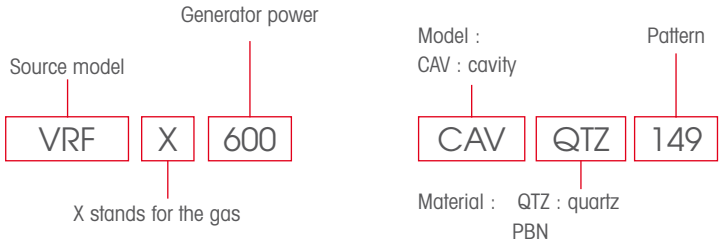
Nitrogen concentration in GaAsN or GaNAsSb alloys versus N valve aperture.
Range of concentration depends on the RF Power, the N Flow in the plasma cell.
A concentration of 7.2% was obtained in GaAsN @ 0.7sccm and 400W

Reference APL 77, 2482 (2000)



Photoluminescence of four single GaInAsN quantum wells. Plasma was ignited in the buffer layer. The different QWs were obtained with a valve position of 0%, 22%, 32% and 48% respectively along the same run.

Product guide



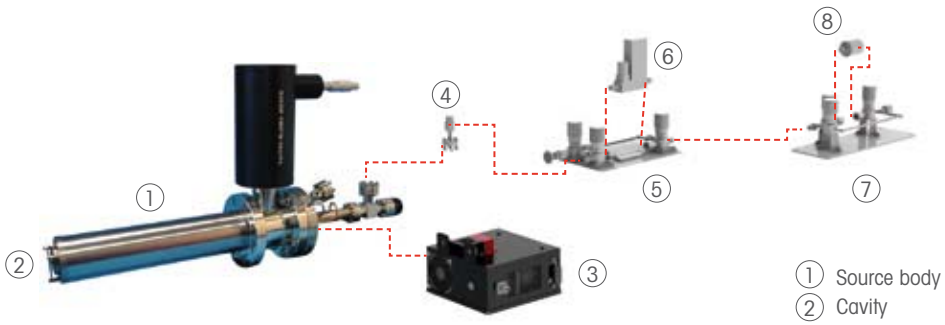
Specifications

		VRF-X-600
Cavity	Material	PBN or MBE grade extra pur quartz only from Riber
	Type	Cavity with end-piece
Generator	Tuning unit	Automatic – manual version also available
	Power supply	600 w
Plasma observation	Viewport	CF 16
Water cooling		Available
Gas inlet		Available
Flux adjustment		Micrometer valve
Options	Plasma light emission detection	Available
	Manual leak valve	Available
	Gas panel + mass flow controller + controller	Available
	Gas purifier panel	Available

Ordering information

Model	Reference	Cavity	
		Model	Reference
VRF-N-600	R 235 016 10 L	CAV QTZ 21	Consult Riber
		CAV QTZ 600	R 330 007 60 Z
		CAV PBN 21	Consult Riber
		CAV PBN	R 330 071 50 V

With the use of Nitrogen gas, Riber recommends a PBN cavity.
For other gas please consult Riber.



1 Source body
2 Cavity

Additional accessories

Item	Equipment	Model	Description	Reference
3	RF Manual matching box	MMB	Manual RF tuning unit with cooling fan and cable Water flow meter and water switch for generator interlock	R 235 046 00 L
3	Automatic Impedance Matcher	AIM	Automatic impedance matcher box with cable Driving electronics Water flow meter and water switch for generator interlock	R 235 046 10 X
4	Leak valve	LKV	All metal leak valve	R 637 450 20 Y
7	Gas purifier panel	GPP	By pass assembly for purifier equipped with two-3 ways manual valve. Purifier not included	R 630 810 00 M
8	Purifier	PURIF N2/Ar		R 630 810 10 Y
5	MFC gas panel	MFCGP	Mass flow gas panel Pumping line to vent entrance allows purge of the high / low pressure stage. Mass flow not included	R 241 162 40 M
6	Mass flow	MFC N	0 - 10 sccm	R 626 700 30 F
-	Mass flow controller	MFC rack	Digitable rackable 19" MFC Controller and cable	R 235 046 30 U
		MFC Top	Digital table top MFC Controller and cable	R 235 046 40 E
-	Plasma light detection detector	ED-FI	Optical detection filter / Low noise amplification of the atomic peak	R 235 030 50 B
-	Flux valve controller	AVP 204	One channel equipped / Rack mountable 19" Including: power cord / mechanical coupling and micrometer electric motorization / necessary cables	R 235 014 20 E

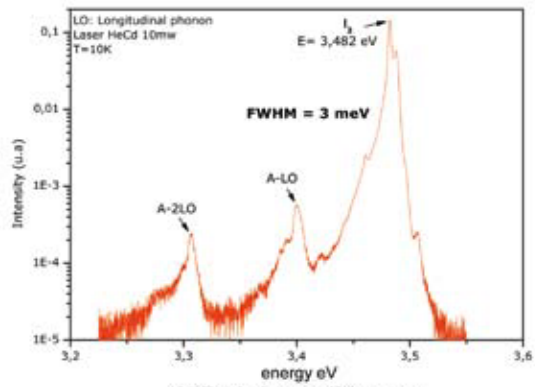
SPECIALITY SOURCES

Ammonia module for Riber Gas Injector

- **Reproducible injection of pre-cracked NH_3**
- **Module designed for handling electronic grade ammonia**
- **Simplicity and ease of operation**
- **Flux adjusted by mass flow controller**
- **Particule free component**

Riber as an alternative to the use of nitrogen and plasma source, offers NH_3 based processes. Pre-cracking of ammonia is achieved with Riber high temperature gas injector. Riber introduces a gas delivery module designed specifically for the control of low flows of electronic grade ammonia. This product enables the user to precisely control the introduction of N and NHx species into an MBE epitaxy chamber. The NH_3 delivery module consists of three assemblies: the gas box including the gas panel, the feed line and the gas injector.

Results

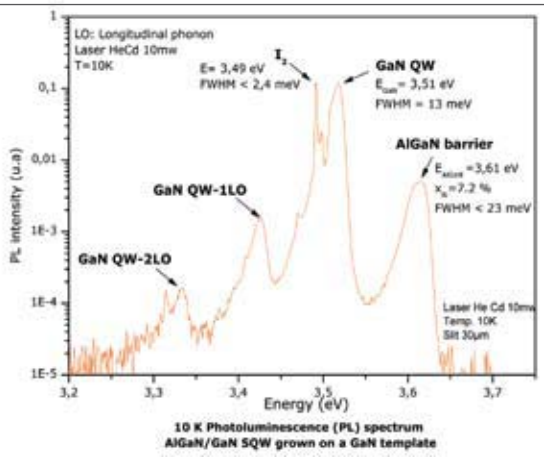


10 K Photoluminescence (PL) spectrum for high purity GaN (2µm) grown on a GaN template

Growth of 2µm thick GaN layer at 800°C, under 200 sccm NH_3 flow rate with a growth rate of 1µm/h on a GaN template.
Photoluminescence results demonstrate the high quality of the sample.

Excellent crystalline quality of GaN

PL spectrum is dominated by the neutral donor bound exciton line I_2 at E=3.482 eV and by two phonon replicas. The I_2 recombination peak exhibits a Full Width at Half of 3 meV.



10 K Photoluminescence (PL) spectrum AlGaN/GaN SQW grown on a GaN template

Growth of AlGaN/GaN quantum well on GaN template. Structure consists of 1 µm thick GaN buffer layer followed by 200 nm AlN barrier. A 26 Angstrom GaN quantum well is then grown and capped with a 50 nm AlGaN barrier.

The quantum well, barrier and buffer layers were grown at 800°C under 200 sccm NH_3 flow rate and at a growth rate close to 1 µm/h.

Excellent optical quality of quantum structures

Photoluminescence spectrum is recorded. The AlGaN peak appears at 3.61 eV corresponding to the targeted Al composition of x=7.2%, the FWHM of the PL peak (less than 23 meV) attests the quality of the AlGaN material. The PL spectrum is dominated by two peaks, the neutral donor bound exciton I2 of the GaN buffer at 3.49 eV and the confined state in the GaN quantum well at 3.51 eV followed by two phonons replicas. The FWHM of the I2 peak of the GaN buffer is better than 2.4 meV. On the other hand, the FWHM of the quantum well PL peak is 13 meV due to the vicinity of the B free exciton luminescence. After deconvolution, the FWHM of the GaN quantum well decreases to less than 10 meV.

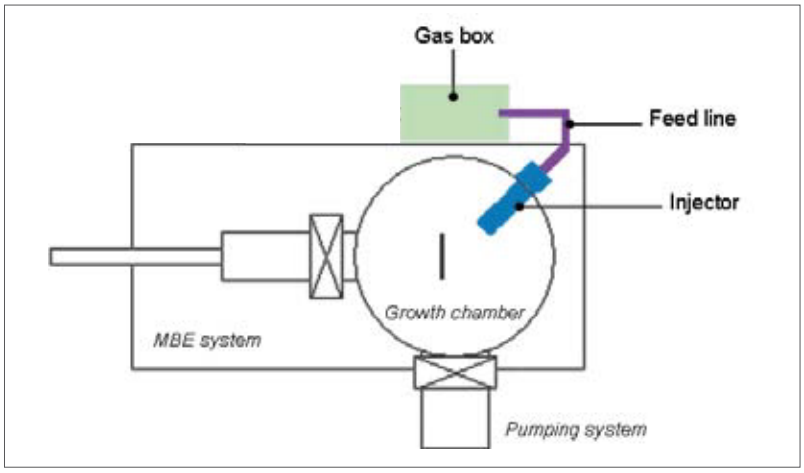
Technical description

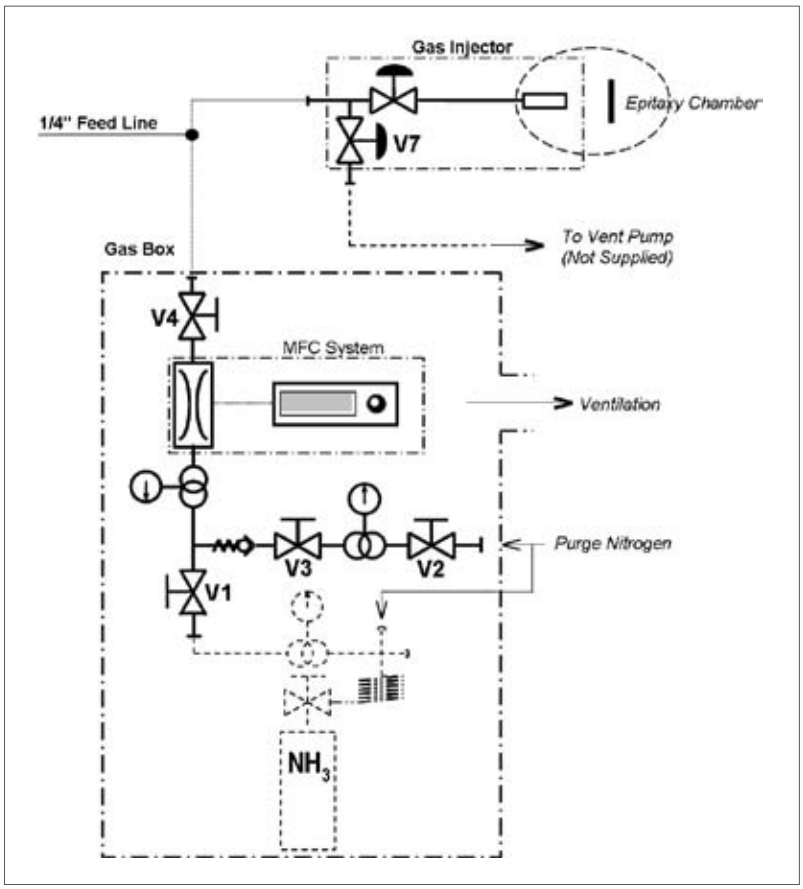
Gax box : A safety gas box includes the low pressure gas panel and the vent pumping system. The gas flow is adjusted by means of a mass flow controller. Shut-off valves as well as Mass Flow Control (MFC) are manually operated from the gas box front panel. Remote control can be performed through Riber Crystal MBE process controller.

Dry pump : Wasted gas is pumped out from the exhaust and vent lines by an oil free rough pump.

Feed line : ¼ inch O.D stainless steel VCR tubing carries the gas flow to the gas injector.

Gas injector : The gas is injected through a 3-way pneumatic run/ vent shut-off valve fitted to the gas injector.





Working principle

Customer supplied NH_3 control assembly (including cylinder, single stage pressure regulator and cross purge) is directly connected to a 2-port manual shut-off valve (V1) through a ¼ VCR fitting. Pure nitrogen is provided to flush the entire gas delivery during idle states to ensure ultra-clean integrity.

High pressure N_2 enters the gas line through a 2-port manual shut-off valve (V2). A pressure regulator reduces the gas pressure from 6 bar maximum to 1.2 absolute bar.

Nitrogen enters the gas line through a 2-port manual shut-off valve (V3). A check valve prevents accidental backflow of NH_3 to the purge line.

NH_3 process pressure is controlled by means of a single stage negative pressure regulator. Inlet pressure is 1.2 bar maximum and outlet pressure is adjustable down to 100 torr.

Upstream positioning of the purge inlet permits purging the regulator high pressure inlet.

Material flux is regulated by mass flow control – MFC- with high sensitivity. Standard accuracy is < ± 1% full scale and repeatability is ± 0.15 % full scale with a control range from 5 to 100% full scale.

A 2-port manual shut-off valves (V4) is used to isolate the MFC during servicing.

¼ inch OD feed line delivers the gas to the injector. The gas is injected through the 3-way pneumatic run/ vent shut-off valves (7) fitted to the gas injector.

Ordering information

Cell model	Reference
NH3 module	R 240 788 80 D

SPECIALITY SOURCES

CBr4 module for Gas Injector

- **High doping levels**
- **Very accurate and reproducible p-type doping**
- **Safe and easy to operate**
- **Flux adjusted by mass flow controller**

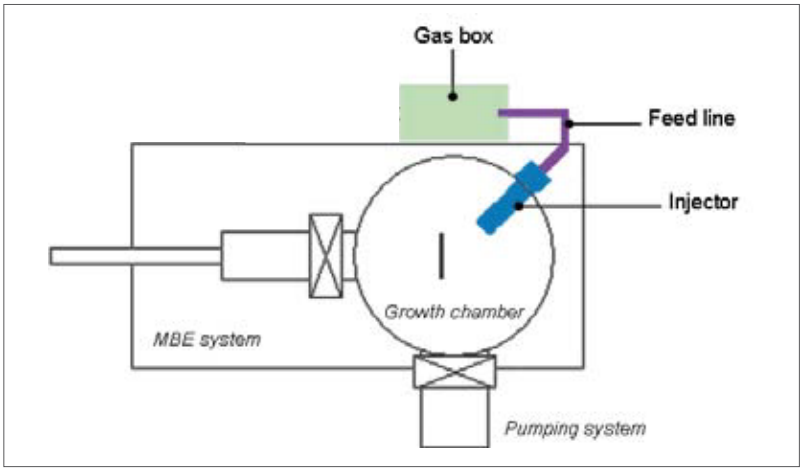
As an alternative to the use of carbon filament source, high doping levels in GaAs, AlGaAs and GaInAsP can be performed by using carbon tetrabromide (CBr4) without carrier gas (by direct evaporation). Hole concentrations of $1x10^{20}$ at/ cm^3 (CBr4 BEP~ $1x10^{-6}$ Torr) in GaAs and $9x10^{19}$ at/cm^3 in InGaAs are reported.
RIBER CBr4 delivery module is intended for use in any MBE application where very accurate and reproducible p-type doping of epitaxial materials is required. Combining the well-known advantages of an ultra-high purity (UHP) gas panel with a real ultraclean UHV gas injector, this product enables the user to precisely control the introduction of very low flow rates of CBr4 (< 5.10^{-3} sccm) into the MBE chamber.

Technical description

Safety and ease of operation are the major features of the design. The gas panel and all the necessary accessories are enclosed within a safety gas box which can be easily attached to the MBE system frame.

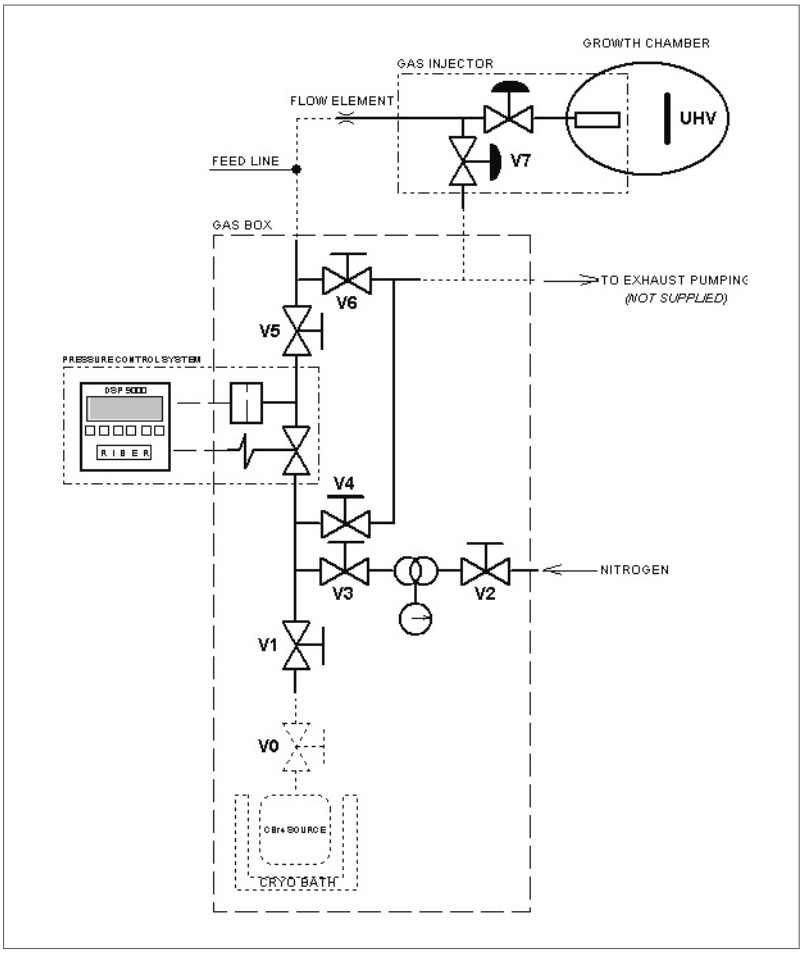
Carbon tetrabromide is brought into the vapor phase so that it can be used in the process. Evaporation is achieved by heating the cylinder through a heating jacket (optional) and by using a pressure control system between the source and the process to control the flow of vapors. The feed line is heated by mean of a heating tape (optional) to preclude condensation due to temperature drops in the pipework.

All the gas flow components (i.e. the manual shut-off valves, the nitrogen pressure regulator, and the DSP 9000 pressure controller, Run/Vent switching operations) are operated from the gas box front panel. Remote control can be performed through Riber Crystal MBE process controller.
Due to the low amount of process gas involved, there is no need for an additional pumping group on the MBE chamber. However, wasted gas are evacuated through the exhaust and vent lines with a corrosive-gas version pump.



Working principle

The gas panel is designed to ultrahigh purity standards in terms of materials and fabrication techniques. Gas flow components are strategically placed to eliminate dead volume. Tubing is 316L SS, and VCR® fittings are used to join components. External leak rate is less than 5 x 10^{-10} at cm^3/s.



The CBr4 cylinder is connected to manual valve V1 through a ¼ VCR fitting. Pure nitrogen can be used as a purge during the idle states to ensure ultra-clean integrity. N_2 enters the panel through the manual valve V2. On/off to the CBr4 gas line is controlled with the manual valve V3. The flux is regulated using a pressure control system. The manual valves V4, V5 and V6 are used to bypass the pressure control system during servicing. A high conductance 1/2" O.D. feed line (customer tailored) joins the gas panel to the gas injector. CBr4 is injected into the MBE chamber through the run/vent pneumatic valve V7 fitted to the RIBER LTI 163H gas injector. This low temperature gas injector ensures safe and precise handling of metalorganics.

Ordering information

Cell model	Reference
CBr4 module	R 240 975 50 X

SPECIALITY SOURCES

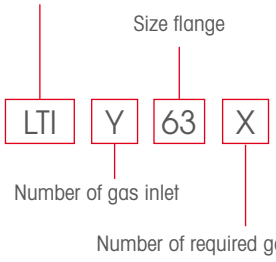
Gas injectors for CBr4, Ammonia, hydrides and others

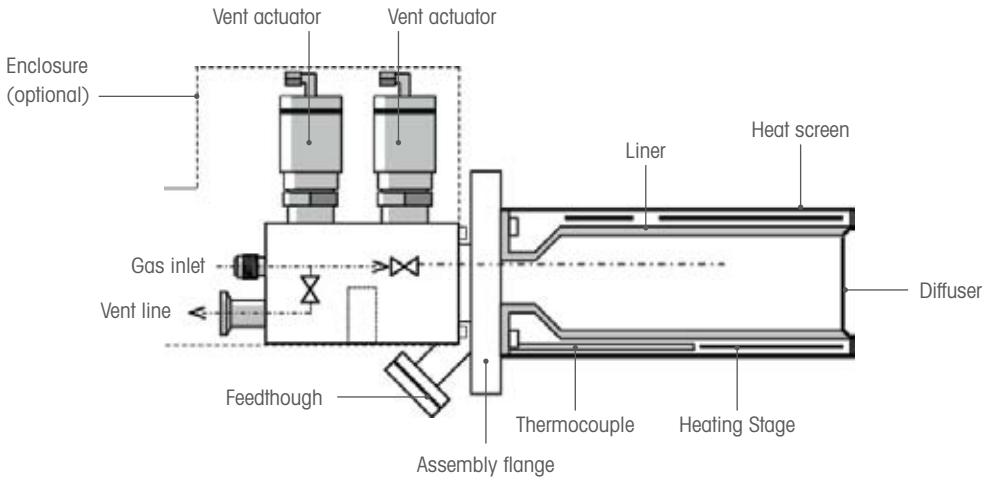
- **Smallest dead volume to produce abrupt interface**
- **Molecular beam with stable and uniform intensity**
- **Integrated Run/Vent valves**
- **Two models at either low or high temperature**
- **Field proven design**
- **Rugged, reliable for long lifetime**

Functions of gas injectors used in gas-source MBE and CBE systems are: (1) the introduction of a gas source into the epitaxy chamber, (2) the generation at the substrate of a molecular beam with stable and uniform intensity, (3) the pre-mixing of different gas sources of the same family within a single injector in order to achieve a high degree of material composition uniformity, and (4) the precracking of species, if required.
Depending on the nature of the precursor and it's thermal stability relative to the growth temperature, the gas injector operate either at a low temperature (< 100°C) for preventing both condensation and dissociation of compounds before on-substrate cracking, or at a high temperature (> 600°C) to thermally decompose the molecular species before impinging on the substrate.
RIBER gas injectors are fitted to the evaporation flange through a standard UHV flange, enabling installation on most gas-source MBE and CBE systems. Gas injectors feature independent 1/4 VCR® male gas inlets handling up to four distinct process gases, depending on model of injector selected. The vent outlet is connected to a vent pump with a DN 16 ISO-KF metal seal fitting for higher pumping speed to optimize gas shut-off and prevent memory effects. Gas injection lines are equipped with high temperature normally closed pneumatic actuators (200°C max.).
The source switching is based on a run/vent operation using a set of two-way valves for each gas line serving the injector. These valves are directly machined in the bulk of the UHV flange, hence the term "valved". The "run" (to the substrate) and "vent" (to the vent pump) switching valves are located as close as possible to the epitaxy chamber to ensure rapid switching of sources with low transient times (< 1sec) to produce abrupt layer interfaces.
Feeding liners consist of high conductance tubes to ensure an efficient mixing of the different injected sources without cross-talk or cross-contamination effects.
Moreover, conductance between the vent and run lines is balanced to prevent overshoots and cross-reactions between gases.

Product guide

Cell model :
LTI : low temperature injector
HTI : high temperature injector



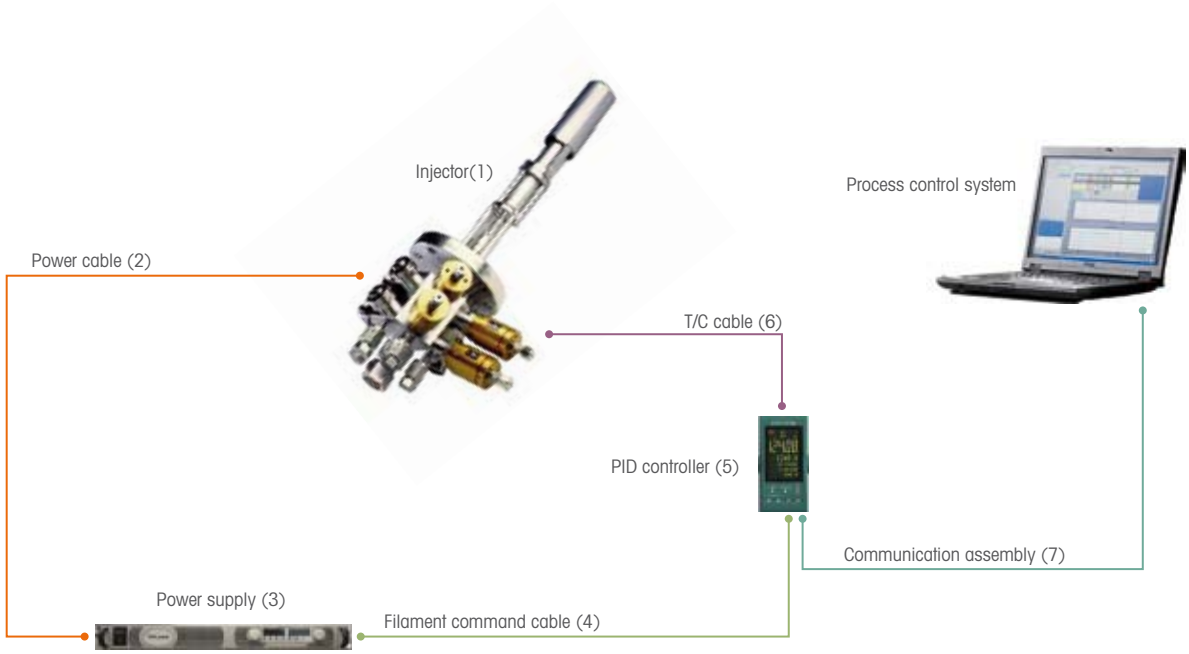


Specifications

	LTI 1-63-X	LTI 4-63-X	HTI 1-63-X	HTI 4-63-X
Maximum gas inlet	1	4	1	4
Number of Run actuactor	1	4	1	4
Number of Vent actuator	1	4	1	4
Gas inlet	¼ VCR			
Typical operating temperature	< 100°C		> 600°C	
Maximum operating temperature	900°C		1100°C	
Heater	Single tantalum filament			
Thermocouple *	C type			
Outgassing temperature	200°C			
Power supply	One power supply One temperature controller			

Ordering information

Number of gas inlet required	Model	Reference
1	LTI 1-63-1	R 240 840 80 F
1	LTI 4-63-1	R 240 974 40 C
2	LTI 4-63-2	R 240 684 50 S
3	LTI 4-63-3	R 240 978 40 M
4	LTI 4-63-4	R 240 831 00 R
1	HTI 1-63-1	R 240 788 60 G
1	HTI-4-63-1	R 240 706 50 H
2	HTI-4-63-2	R 240 667 80 B
4	HTI-4-63-4	R 240 711 80 J



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Length 8 m	1	R 252 270 40 D
3	Power supply	One channel 1kW DC Rack mountable / Power cord included	1	R 270 522 70 Z
4	Command cable	Length 2,5 m	1	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / WRe / Rack mountable / Power cord included	1	R 461 110 00 K
6	T/C cable - W-Re	Length 11 m	1	R 252 304 30 N
7	Communication assembly		-	Consult Riber

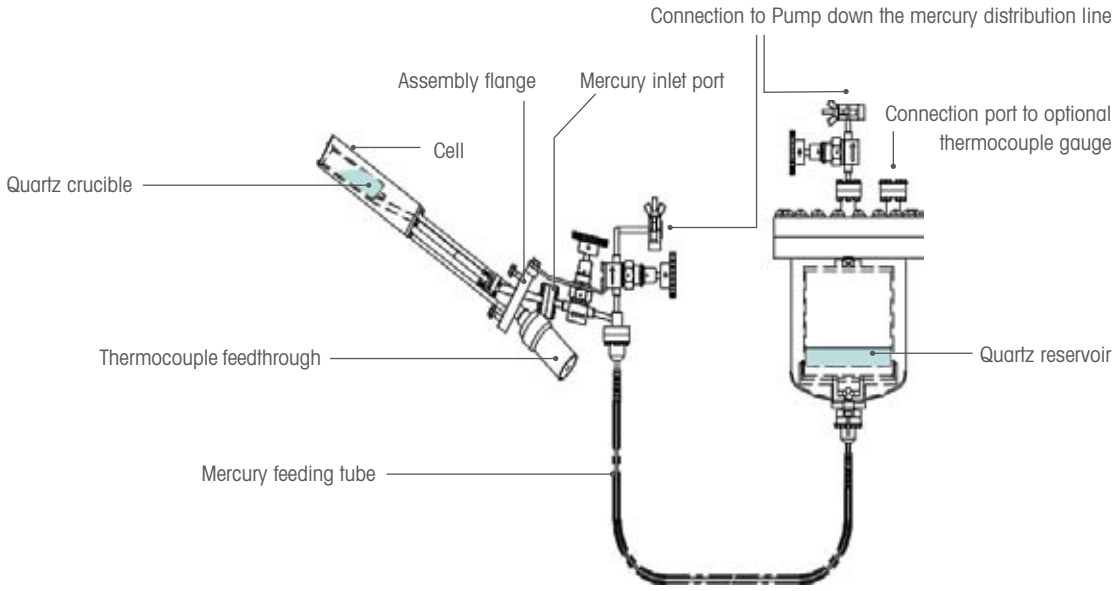
SPECIALITY SOURCES

Mercury source – MCL

- **Field proven technology since 20 years**
- **High clealiness operation**
- **Large mercury capacity**
- **Refill without breaking growth chamber vacuum**
- **Constant flux for hours**
- **Run to run compositional reproducibility**
- **Easy to use, to maintain, allows bakeout operation**

Riber Mercury cell, model MCL allows to growth thick MCT layers with precise control in composition for Infra-Red devices. MCL source provides a constant mercury level in a conventional cell configuration, connected to a large reservoir. Gravity keeps constant the level of mercury between the cell and the reservoir. A sensor located in the effusion cell allows to adjust the level of Mercury by mean of the reservoir motion. The large difference between the surface area of the Mercury in the cell and in the reservoir, does not require to move the reservoir during the growth. Growing 10µm of MCT epilayers at 200°C only requires 1mm of mercury level in the cell. With the level sensor, Mercury level is easily returned to its original pre-calibrated level for the start of each new growth.

Precise control of the cell temperature combined to the Mercury level setting enables an excellent flux stability and reproducibility. The cell is also designed to have a rapid thermal response to temperature changes, for rapid flux variations. This feature is especially useful for applications which specifically require graded doping and composition.

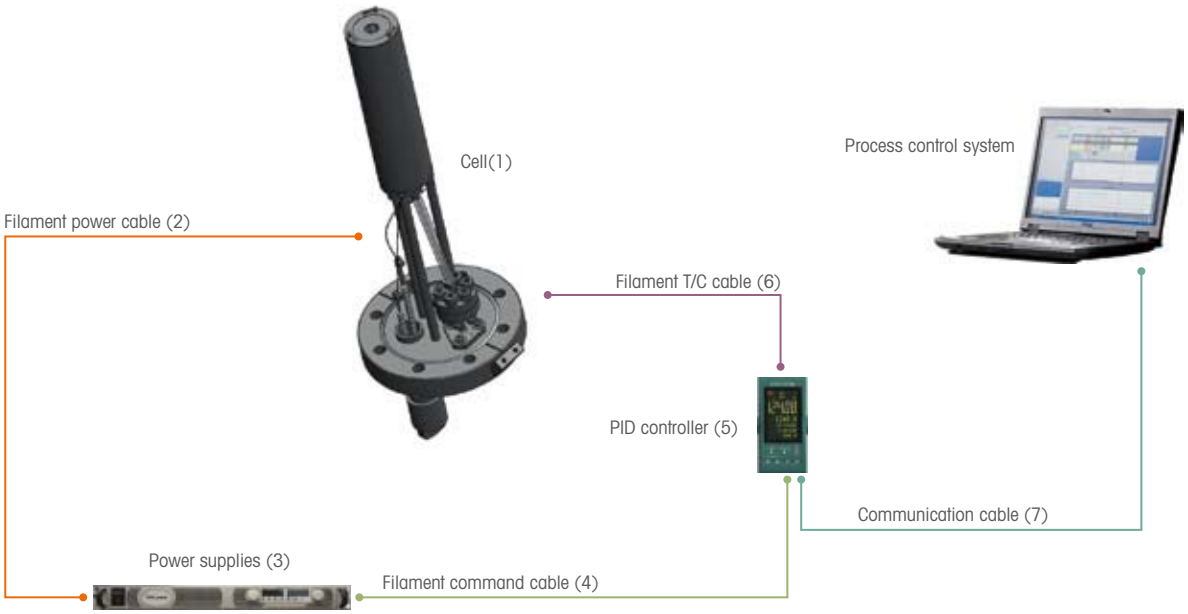


Specifications

	MCL 160
Pressure operating range	10^{-12} – 10^{-13} Torr
Maximum pressure	10^{-3} Torr
Reservoir capacity	1100 cc
Reservoir material	Quartz
Crucible material	Quartz
Cell heating	Flat Tantalum filament
Typical operating temperature	Up to 600°C
Maximum outgassing temperature	700°C
Temperature stability	0.2°C
Power supply	One power supply / One temperature controller

Ordering information

Model	Reference
MCL 160	R 240 284 01 K



Additional accessories

Item	Equipment	Model	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	1	R 252 270 40 D
3	Power supply	One channel 1 kW DC / Rack mountable 19'' wide / 1U high / Power cord included	1	R 461 180 18 N
4	Command cable	Length 2,5 m	1	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / power cord included	1	R 461 110 00 K
6	T/C cable - W-Re	Length 11 m	1	R 252 304 30 N
7	Communication assembly		-	Consult Riber
	Thermocouple gauge		-	Consult Riber
	Pumping line		-	R 240 315 72 G

SPECIALITY SOURCES

Source for Alcaline materials NAKCS

- **Dedicated to Na, K, Cs, Rb**
- **Loading charge protected from water**
- **Simple concept**
- **Easy to use**

Riber NACKS source for alcaline materials is a good alternative to standard low temperature effusion cell. Indeed, alcaline materials are extremely reactive with water so it is important to protect the loading charge.

Working principle

In NACKS source, the charge packaged in its quartz capsule is loaded as a all into the reservoir. Maximum capacity is about 100 cc. The reservoir is pumped down, and at a given pressure, operator by mean of a simple mechanism, breaks the capsule releasing the material. The reservoir is heated. The effective thermal gradient allows to transfer material from the capsule to the reservoir. Reservoir is heated up to the needed temperature according to operator desired BEP. Valve and vapor tube are heated to prevent from material condensation. Flux delivery into the reactor is controlled by mean of an ON / OFF valve. Temperature control is effected by standard PID regulators.

Ordering information : Please contact us

LOW TEMPERATURE MATERIALS

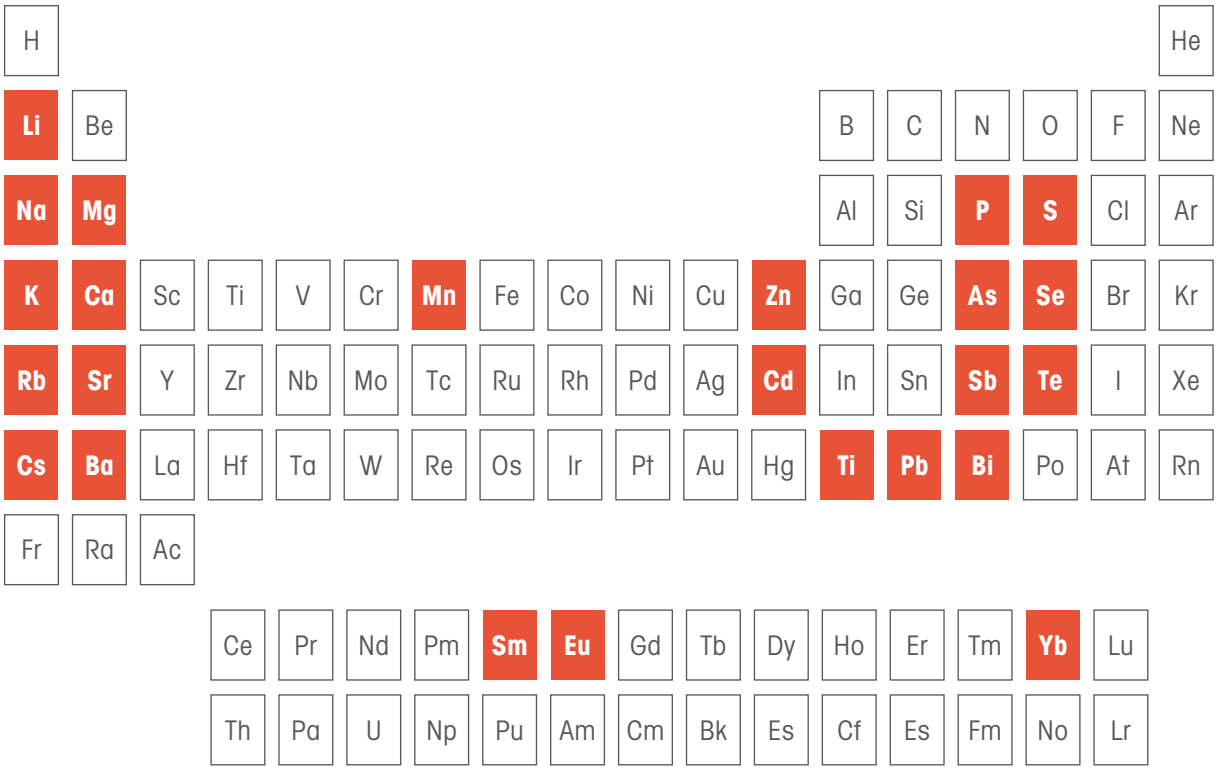
Low temperature DZ MM source

Valved cracker source for Arsenic

Valved cracker source for Phosphorus

Valved corrosive source
for Antimony / Magnesium / Tellurium

Low temperature effusion source



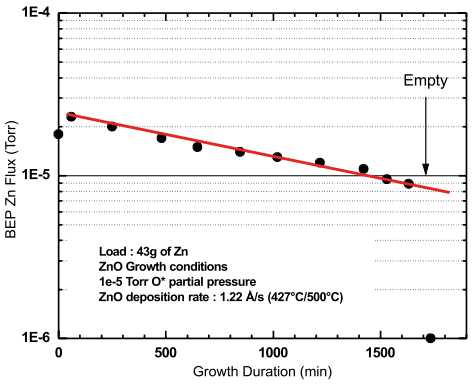
LOW TEMPERATURE MATERIALS

Low temperature source – DZ MM technology

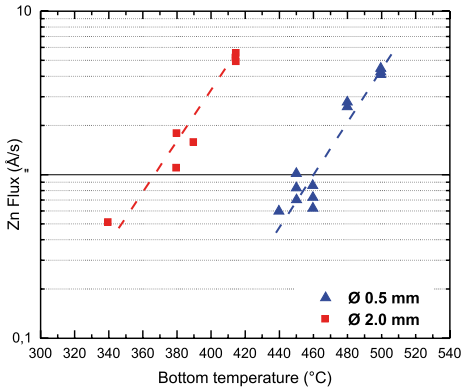
- **High loading capacity**
- **Easy maintenance and re-filling operations**
- **Thickness uniformity independent of the filling level**
- **Eliminates flux drift due to filling level**
- **Loaded charge is protected from corrosive or oxidizing environments**

Riber DZ MM Technology is used for the evaporation of high pressure metals and compounds. The material is loaded in a PNB crucible fitted with an insert at the cell mouth. Insert design defines the shape of the flux beam. Narrowing or widening beam distribution, for reaching high uniformities. In addition, the DZ MM insert design suppresses corrosion of the loaded material when used in a corrosive environment such as oxygen, selenium… Oven thermal gradient prevents any clogging effect during operation.
Maintenance and refilling procedure are straight forward and easy to accomplish.

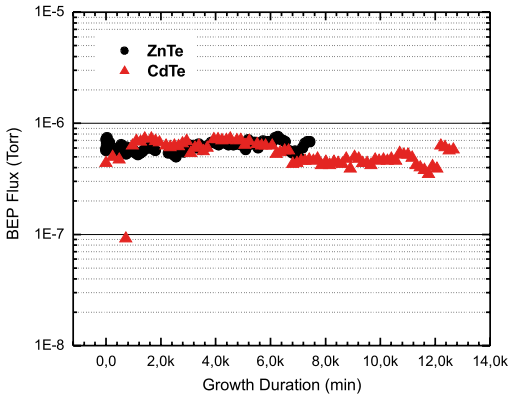
Results



Growth of ZnO crystal is performed under $3x10^{-5}$ Torr of oxygen radicals (RF source). Zinc is evaporated with a DZ-MM Source (load 43gr). MM technology prevents oxidation of the load by oxygen residual pressure in the chamber as it happens after one or two runs with standard K-cell.



ZnO deposition rate versus crucible bottom temperature. The insert end shape changes the working conditions of the cell. Higher the hole diameter, lower the working temperature, lower the pressure in the crucible.



The insert restricts the effusion area of the source compare to an open crucible.
As a consequence, the pressure over the load is higher than in standard open crucible effusion source.
It provides a much stable flux, because the flux is independent of the filling level and / or the evaporation area.

Product guide

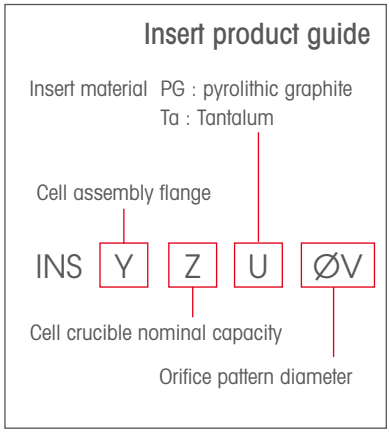
Cell model

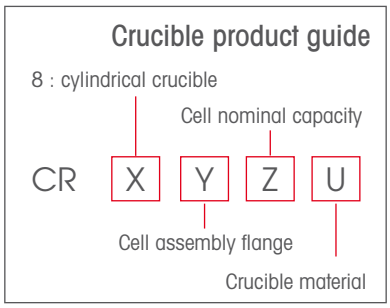
Crucible capacity

DZ MM X

Specifications

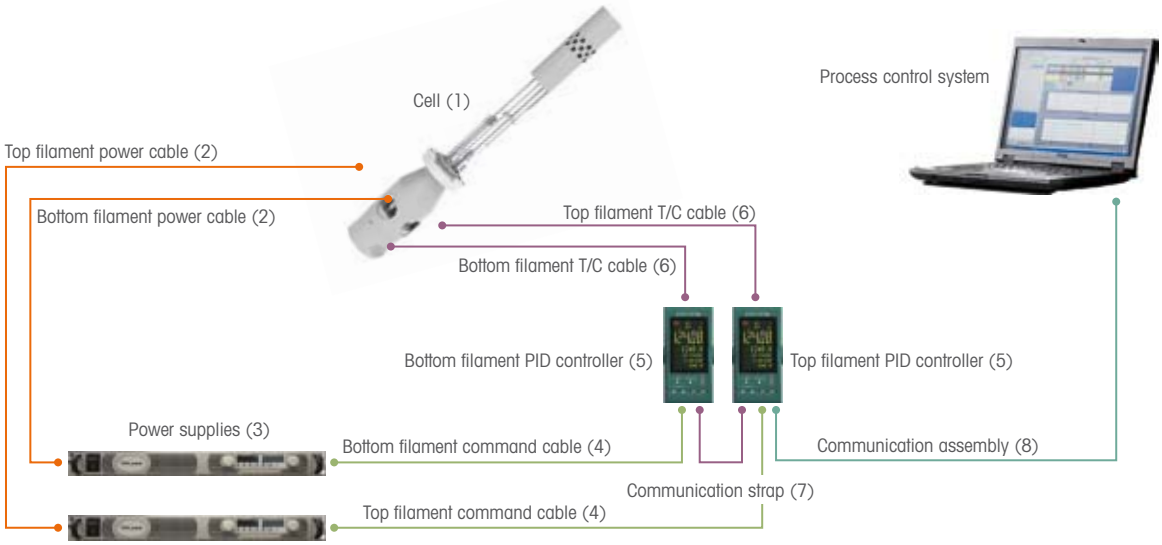
	DZ MM 17	DZ MM 28
Assembly flange	CF 40	CF 63
Heating element	Double Tantalum wire filament	
Thermocouple	Two - K - type	
Crucible material	PNB	
Crucible nominal capacity	17 cc	28 cc
Insert material	Refractory metal / PG	
Typical operating temperature	100 - 950°C	
Maximum outgassing temperature	1100°C	
Temperature stability	± 0.1°C	
Power consumption	300 W / 300 W	250 W / 250 W
Power connection	RI5 (Ø5)	
T/C connection	Omega type	





Ordering information

Model	Reference	Crucible		Insert	
		Model	reference	Model	Reference
DZ MM 17	Consult Riber	CR 835025 PBN	R 302 776 40 L	INS 35035 Ta Ø1	Consult Riber
				INS 35025 PG Ø1	R 330 106 20 S
DZ MM 28	R235 029 10 Z	CR 835035 PBN	R 330 009 00 B	INS 35035 Ta Ø0.7	R 330 064 00 E
				INS 35035 Ta Ø2	R 330 110 80



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	2	R 252 270 40 D
3	Power supply	One channel 750W DC / Rack mountable 19"wide / 1U high / Power cord included	2	R 461 225 16 C
4	Command cable	Length 2,5 m	2	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / Power cord included	2	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	2	R 252 304 30 N
7	Communication strap	To PID controller	1	R 252 297 60 K
8	Communication assembly		-	Consult Riber

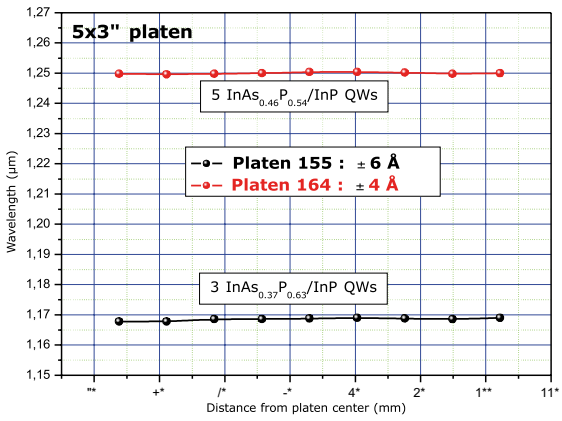
LOW TEMPERATURE MATERIALS

Valved cracker cell for Arsenic

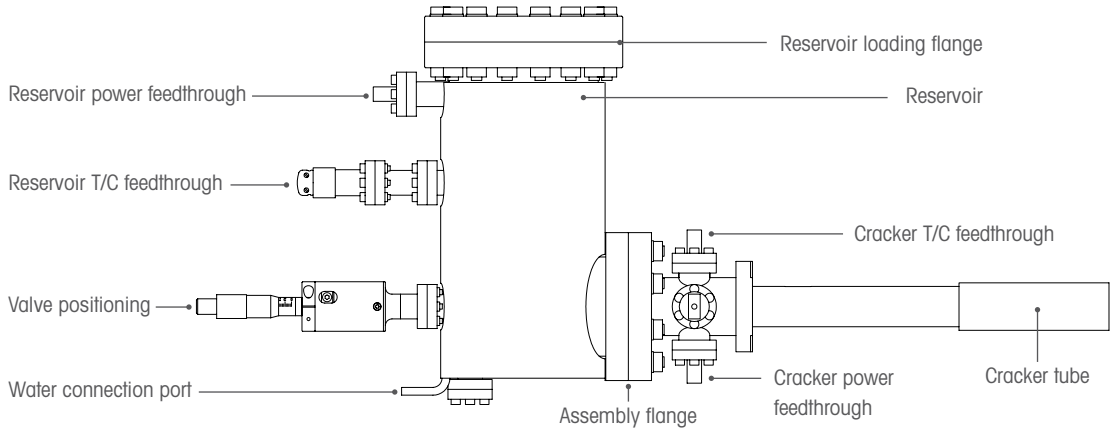
- **More than 150 in the field**
- **Flux modulation reproducible to within1%**
- **Fast and precise on/off control over arsenic BEP**
- **Extended lifetime before refilling**
- **Rugged and reliable**

Riber valve cracker consists of three main parts : the reservoir, the isolation valve and the cracker stage.
Solid arsenic is loaded through a CF port into the reservoir crucible. The reservoir is externally water cooled for an efficient heat dissipation.
The metering valve is located downstream of the crucible, allowing exact control of the amount of As_4 entering the feeding tube. This design allows the valve to operate at low temperatures and since it is thermally isolated from the cracker section, immediate start up and long term flux stability is achieved even if the cracker temperature is cycled. This valve is operated with either a manual micrometer or an automated position controller. The evaporant enters a feeding tube and cracking zone, tantalum filaments resistively heating both these assemblies. The cracker stage generates beams of cracked or uncracked material. Geometry of the diffuser has been optimised to provide a uniform flux on the substrate.
In addition to providing users with a large capacity arsenic source for increased system uptime, the valved cracker cell permits precise control over small or large variations in BEP with rapid shut-off capability. As well as ease of isolating the bulk material from the epitaxy chamber, it also permits growth of advanced stacked structures, previously impossible to obtain using conventional MBE sources.

Results



Photoluminescence spectra of InAsP/InP multi quantum wells. Composition of the InAsP quantum well is highly dependent on the As/P flux ratio and on the substrate temperature over the platen.
±4Å for the optimal V/III ratio, corresponding to a As/P composition variation of ± 0.05%

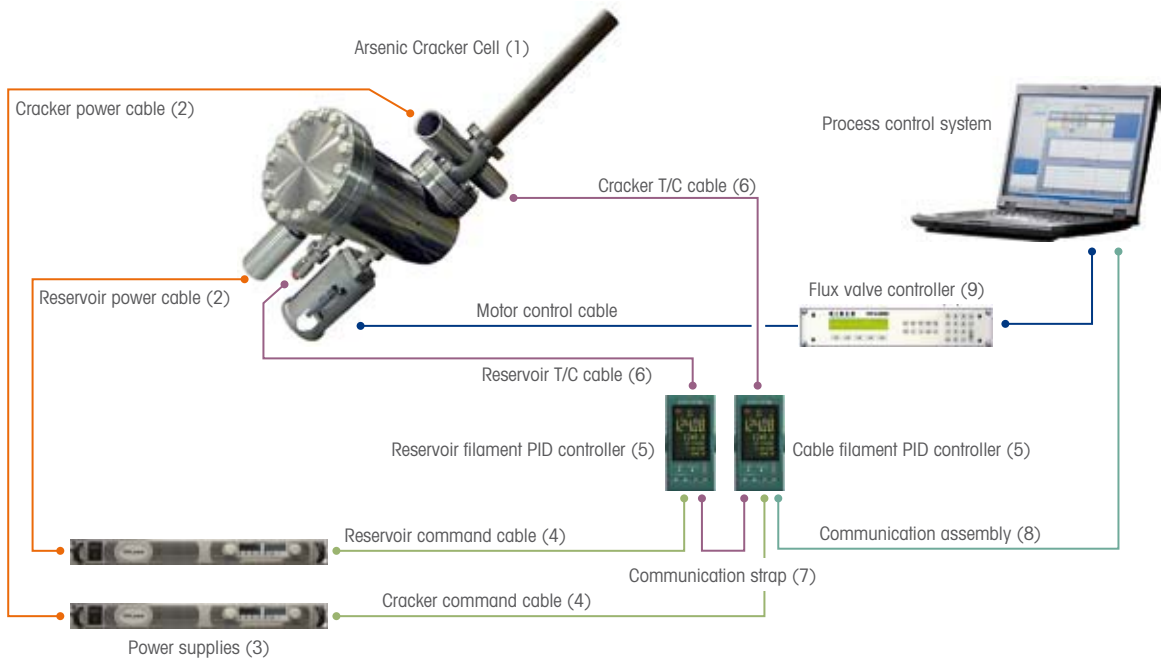


Specifications

		VAC 500	VCAS 700
Reservoir	Flange size	CF 100	CF 100
	Crucible capacity	550 cc	700 cc
	Loading dimension in mm	Ø58 – H146	Ø80 – H140
	Maximum temperature	550°C (50V - 6A)	550°C
	Typical operating temperature	350 - 400°C	
	Heating mode	Resistance / radiation	
	Material	Tantalum	
	Power supply	One power supply - One temperature controller	
	Water cooled	Available	
Cracker stage	Maximum temperature	1300°C (30V-10A)	1350°C
	Typical operating temperature	800 - 900°C	
	Heating mode	Resistance/ radiation	
	Oven material	Tantalum – PBN	
	Power supply	One power supply - One temperature controller	
	Water cooled assembly	In option	
Valve	Actuator	Micrometer rotating thimble	
	Control	Automatic valve positioner - Manual version also available	

Ordering information

Model	Reference
VAC 500	R 240 666 61 X
VCAS 700	R 235 016 00 A



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	2	R 252 270 40 D
3	Power supply	One channel (60V - 12,5A) DC / Rack mountable 19" wide / 1U high / Power cord included	2	R 461 225 00 K
4	Command cable	Length 2,5 m	2	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / Power cord included	2	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	2	R 252 304 30 N
7	Communication strap	To PID controller	1	R 252 297 60 K
8	Communication assembly		-	Consult Riber
9	Flux valve controller	One channel equipped / Two spares / Rack mountable 19" / 3U high Including : AC power cord / Mechanical coupling and micrometer electric motorization / Necessary cables	1	R 270 522 00 Y

LOW TEMPERATURE MATERIALS

Valved cracker cell for Phosphorus

- **More than 100 in the field**
- **« Zero- burst » patented design**
- **Three-zone temperature concept**
- **Fast and precise control over phosphorus flux**
- **100% leak tight all metal metering valve**
- **Rugged and reliable**

Riber Valved cracker for phosphorus is designed to provide a safe, simple and highly effective phosphorus source. This multi-zone cell is based upon a patented process to first generate white phosphorus from a commercially available red phosphorus charge and then use this highly vapour pressure element to produce very stable P_2 fluxes, which can be quickly and precisely adjusted with a very good repeatability, permetting the growth of P-containing layers, such as InP, GaInP, GaInAsP …

The valved cracker consists of three main parts : the reservoir, the isolation valve and the cracker stage.
The reservoir is made of two sub-assemblies, the evaporator and the condenser.

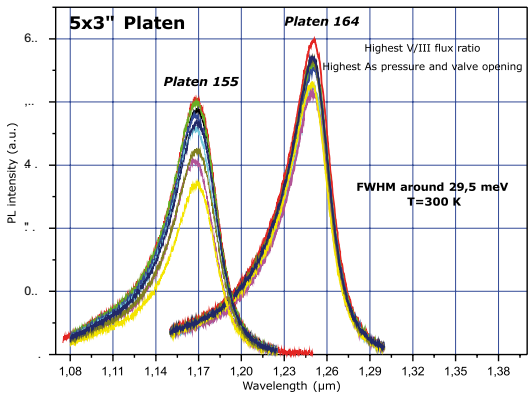
Working principle

The evaporator is placed inside the condenser and is meant to receive the Red phosphorus primary loaded charge. For easy loading operation, the evaporator heated crucible is mounted on an independent base flange. After loading, the red phosphorus is heated to evaporation temperature to produce P_4 that will condense into white phosphorus. The condenser surrounds the red phosphorus evaporator and is connected to the flux valve. An isolation valve allows to vent and pump down the condenser during re-loading operations. P_4 vapour condenses on white phosphorus and the condenser wall and is re-evaporated at a rate which depends on the condenser temperature, typically 60/100°C. The condenser is set in a thermostatic enclosure, allowing an independent control of the condenser temperature between 40-120°C. The enclosure is heated with a fan assisted forced air circulation, temperature is monitored by a controller.
An all-metal valve is placed between the condenser and the cracker stage. It is fully independent and can easily be serviced or replaced. The micrometer driving mechanism enables fine adjustement and complete interruption of the phosphorus flux to the cracker. The valve is fully leak tight in close position allowing to reload the cell without venting. The valve is externally heated by mean of a heated jacket connected to prevent white phosphorus condensation on the valve mechanism.
The cracker stage is inserted inside the growth chamber and is connected to the valve. A large conductance transit tube allows the transfer of P_4 molecules to the cracking zone.The cracker stage design allows an efficient dissociation of the P_4 molecules to dimmers. The cracker is heated by mean of flat Ta filament. A WRe thermocouple is used to monitor the cracker stage temperature.

Independent and optional water panel can be provided around the cracker to limit the heat load in the growth chamber.

Cracking process

Results



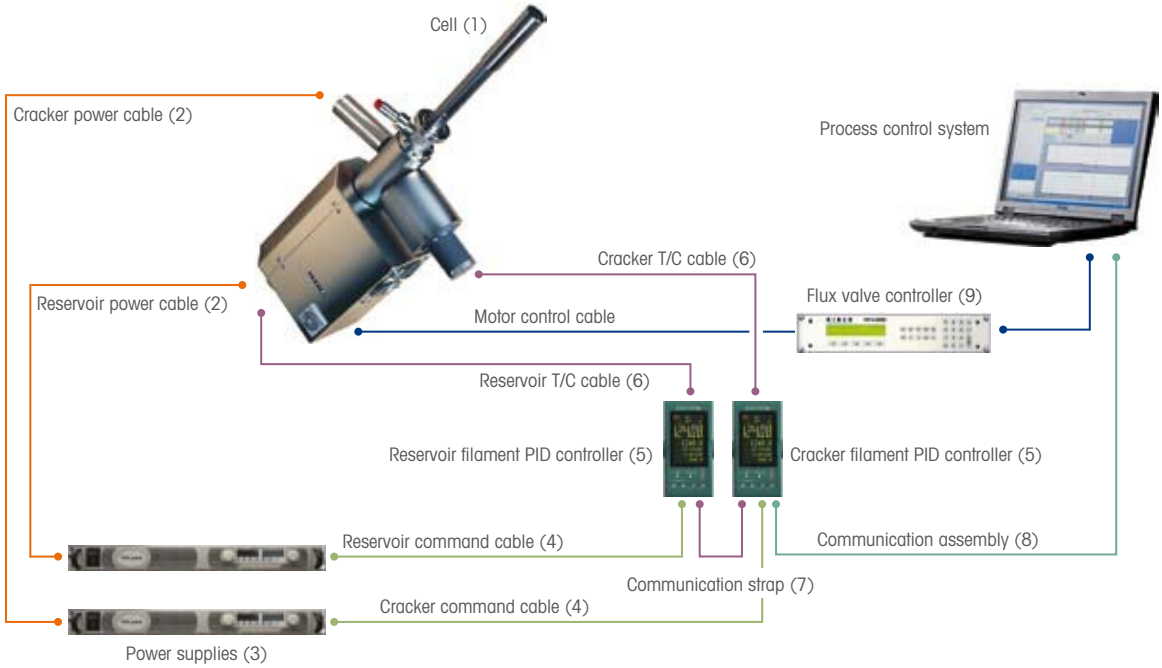
Photoluminescence spectra of InAsP/InP multi quantum wells. Composition of the InAsP quantum well is highly dependent on the As/P flux ratio and on the substrate temperature over the platen.
±4Å for the optimal V/III ratio, corresponding to a As/P composition variation of ± 0.05%

Specifications

		KPC 250
Evaporator	Flange size	CF 63
	Crucible capacity	250 cc
	Maximum temperature	550°C (12V – 5A)
	Operating temperature	325-400°C
	Heating mode	Resistance / Radiation
	Materials	Tantalum – high purity alumina
	Power supply	One power supply - One temperature controller
Condenser	Maximum temperature	120°C
	Operating temperature	50-60°C
	Heating mode	Thermostatic enclosure builtin PID power supply
Cracker stage	Maximum temperature	1300°C (40V-12A)
	Typical operating temperature	800-900°C
	Power supply	One power supply - One temperature controller
	Heating mode	Resistance / Radiation
	Oven material	Tantalum – PBN
	Filament type	Tantalum flat filament
Valve	Actuator	Micrometer valve
	Heater	External heater jacket
	Actuator control	Automatic valve positioner. - Manual version also available

Ordering information

Model	Reference
KPC 250	R 240 897 41 J



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	2	R 252 270 40 D
3	Power supply	One channel 750W DC / Rack mountable 19" wide / 1U high / Power cord included	2	R 461 225 16 C
4	Command cable	Length 2,5 m	2	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / Power cord included	2	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	2	R 252 304 30 N
7	Communication strap	To PID controller	1	R 252 297 60 K
8	Communication assembly		-	Consult Riber
9	Flux valve controller	One channel equipped / Two spares / Rack mountable 19" / 3U high Including : AC power cord / Mechanical coupling and micrometer electric motorization / Necessary cables	1	R 270 522 00 Y

Services

Necessary phosphorus production leads to the step of formation of white phosphorus which is extremely toxic to humans. Under standard conditions cracker cells are built to limit any remaining white phosphorus in the condenser. For operators to feel secure with phosphorus handling, Riber offers a complete service pack including a complete cleaning and refurbishing of your phosphorus valved cracker cell at Riber plant. Please contact Riber for more information about our service pack offer.

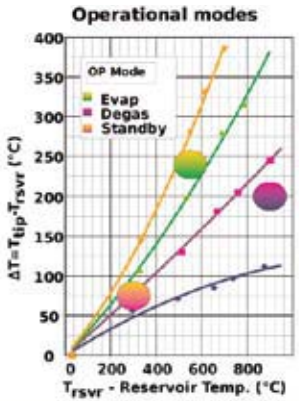
LOW TEMPERATURE MATERIALS

Valved corrosive source for Antimony, Magnesium, Tellurium

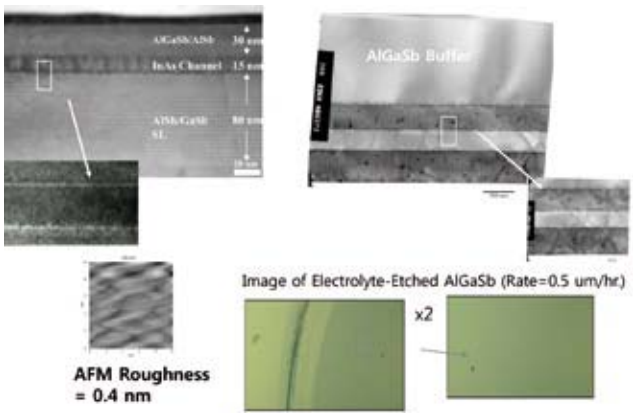
- **Performance, flexibility, reliability**
- **Reproducible flux control**
- **110 cm³ real loading capacity (700 gr of Antimony)**
- **Full PBN reservoir and valve**
- **Simple charge loading (no valve dismantling)**

Riber Valved Corrosive Source, model VCOR is a compact valved source dedicated for corrosive material evaporation. The 110 cm³ loading capacity is fully exploited by the use of cylindrical charges.
A valve mechanism allows rapid and accurate flux adjustments over a decade and shuts off the flux over more than 1 order of magnitude by simply rotating the thimble in conventional directions. Both reservoir and tip filaments permit to heat independently the vapour outlet, avoiding any material blocking. Reservoir and tip thermocouples are embedded within the oven assembly to allow loading without disconnecting feedthroughs. Loading operation only requires the replacement of a CF63 gasket. The all PBN valve avoids the use of Tantalum or other metals in the path of the process vapour. The outside body of the source is water cooled to reduce overheating. The valve is operated with an automated position controller.

Results



With the unique design of the heaters, a wide range of temperature differential can be maintained between the tip and the reservoir. This ensures the achievement of optimum working conditions for different material evaporation.
The achievable temperature gradient between tip and reservoir is shown in the plot which demonstrates the flexibility of the Riber VCOR source.



Growth of a metamorphic HEMT structure on Si(001) substrate. The surface morphology is excellent with a very low defect density. InAs/AlGaSb FET on Si(001) shows room temperature electron mobility of 16,000 cm^2/V-s with a low defect density.

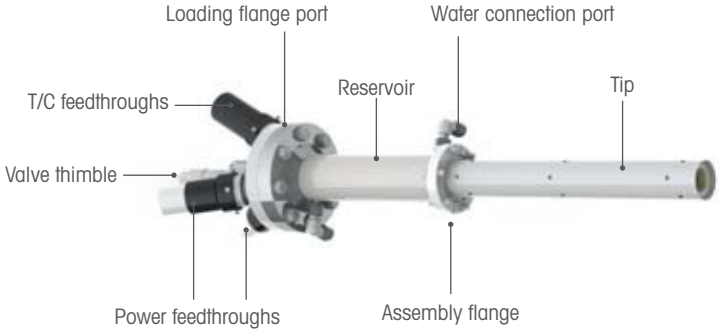
(Courtesy by Prof. Jae-Eung Oh / K.-M. Ko, Nanotech. 20 (2009))

Product guide

Crucible capacity : 110 cc

Cell model

VCOR | 110

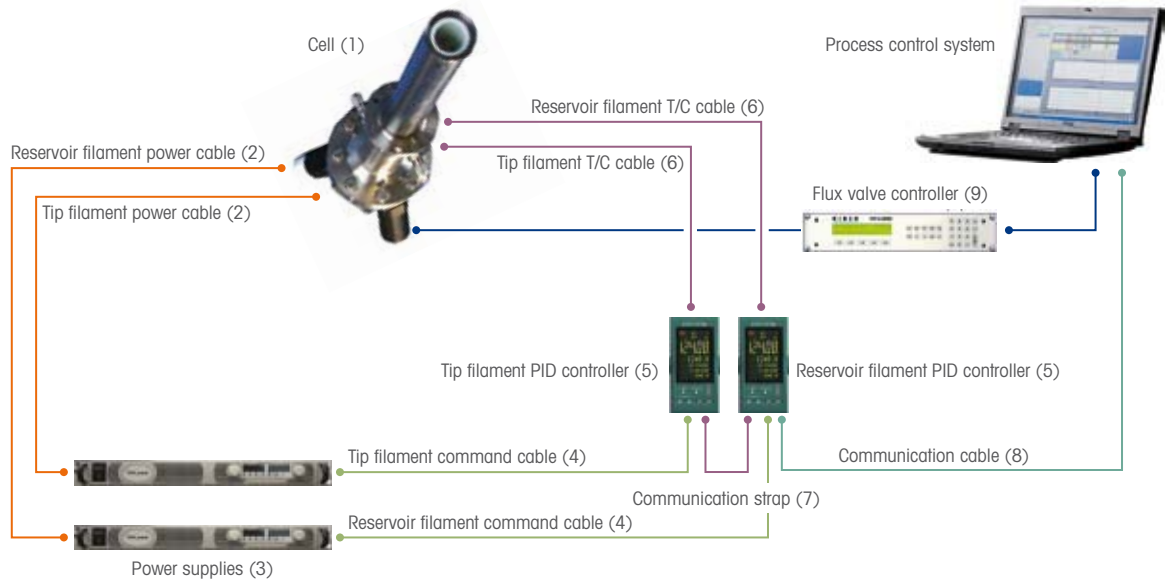


Specifications

		VCOR 110
Reservoir	Useful capacity	110 cc (Ø20 x 350mm)
	Crucible material	PNB
	Loading flange	CF 63
	Typical operating temperature	450 – 700°C
	Maximum outgassing temperature	900°C
	Temperature stability	±0.2°C
	Heater	Single Tantalum wire filament
	Thermocouple	C-type
	Water cooling	Yes
Tip	Material	PBN
	Typical operating temperature	650 -900°C
	Maximum outgasing temperature	1100°C
	Heater	Single Tantalum wire filament
	Thermocouple	C-type

Ordering information

Model	Reference
VCOR 110	R 235 004 80 H



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Length 8 m / Fully bakeable to 200°C	2	R 252 270 40 D
3	Power supply	One channel 750W DC Rack mountable 19" wide / 1U high / Power cord included	2	R 461 225 16 C
4	Command cable	Length 2,5 m	2	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / rack mountable / power cord included	2	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	2	R 252 304 30 N
7	Communication strap	To PID controller	1	R 252 297 60 K
8	Communication assembly		-	Consult Riber
9	Flux valve controller	One channel equipped / Two spares Rack mountable 19" / 3U high Including : AC power cord Mechanical coupling and micrometer electric motorization Necessary cables	1	Consult Riber

LOW TEMPERATURE MATERIALS

Low temperature effusion source

- **Optimized performances at low temperatures**
- **Provide pure, stable and reproducible fluxes**
- **Uniformities better than ±1%**
- **Rugged and reliable design**
- **Single filament or Top filament design to increase performance**

Riber offers a comprehensive range of effusion cells for mounting of the MBE 32 / 2300 systems. Single filament cell is the most commonly used as it is suitable for a large range of elements and compounds. However for high vapor pressure materials, wich tend to condense on the crucible mouth, Riber recommends the use of a top filament design. These cells feature a single filament located at the top of the orifice to produce a much lower gradient along the length of the crucible. These type of cells are ideal for Cadmium, Selenium, Tellurium for instance.

Single filament and top filament design

Product guide

Cell model
X : 125 or 135

T/C type : K : Cr/Al

ABN X | Y | Z

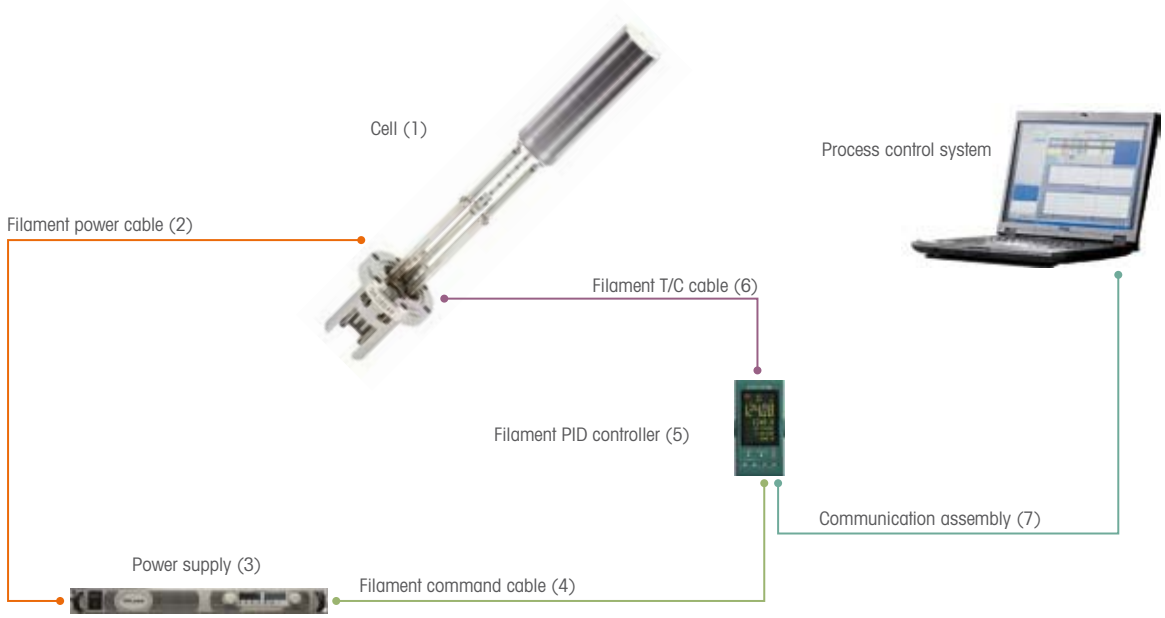
Filament design : SF : single filament
TF : top filament

Specifications

	ABN 125 SF K	ABN 135 SF K	ABN 135 TF K
Source nominal capacity	25 cc	35 cc	35 cc
Uniformities	<± 1%		
Crucible shape	Cylindrical		
Crucible taper	1°		
Crucible material	PBN		
Filament type	Flat Tantalum filament		
Thermocouple type	One K type		
Typical operating temperature	100 - 900°C		
Maximum outgassing temperature	1000°C		
Power supply	One power supply / One temperature controller		

Ordering information

Model	Reference	Crucible reference
ABN 125 SF K	R 240 732 50 J	R 302 776 40 L
ABN 135 SF K	R 240 731 60 V	R 302 750 00 S
ABN 135 TF K	R 240 731 90 V	R 302 750 00 S



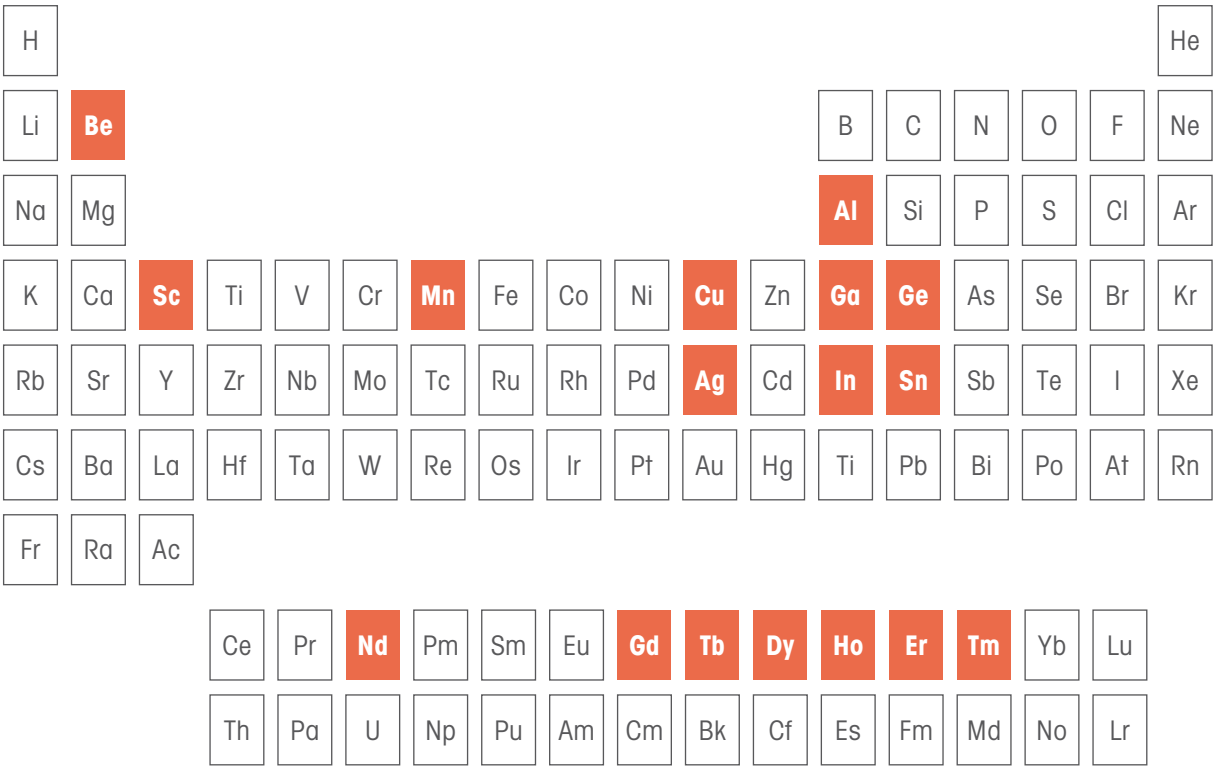
Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	1	R 252 270 40 D
3	Power supply	One channel (30 V - 25 A) kW DC / Rack mountable 19'' wide / 1/2 U high / Power cord included	1	R 461 225 10 W
4	Command cable	Length 5 m	1	R 252 323 30 D
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / power cord included	1	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	1	R 252 304 30 N
7	Communication assembly		-	Consult Riber

MEDIUM TEMPERATURE MATERIALS

MS source for Gallium and Indium

Medium temperature effusion source



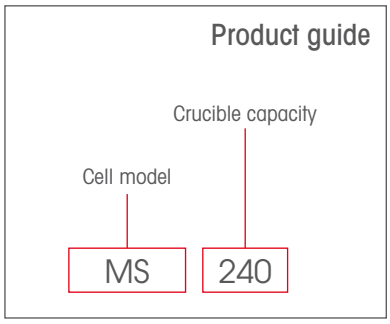
MEDIUM TEMPERATURE MATERIALS

MS source for Gallium and Indium

- **High loading capacity**
- **Excellent flux stability**
- **Outstanding uniformity**
- **High reliability, high duability, low maintenance**

Riber Muscle Source benefits from MS technology which consists of a specific crucible design combining high performance with low operation and maintenance costs. The ultra pure beam of stable flux is a result of the muscle source crucible concept. The crucible is designed in two parts: the reservoir containing the material, and the effusion nozzle screwed above the reservoir. The reservoir shape allows loading of a single piece of material. A specially produced charge matched perfectly to the dimensions of the reservoir, allows the use of extremely pure material resulting in high layer performance. The nozzle shape defines the space distribution of the flux. This innovative design permits a narrow or wide flux beam, governing material consumption and defining uniformity criteria for each system geometry.
Riber MS technology is recommended for medium temperature evaporation material. Crucibles are made of Pyrolitic Graphite which not wet by Ga or In. The muscle cell nominal capacity is 240 gr of Gallium.

Product guide

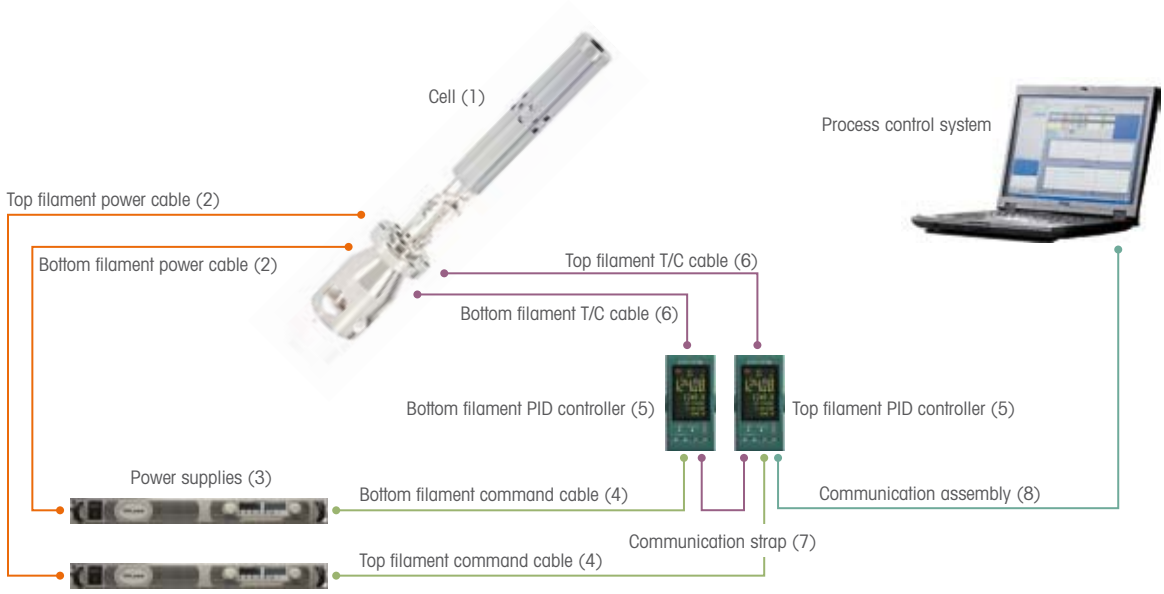


Specifications

	MS 240
Crucible nominal capacity	240 gr of Ga / 300 gr of In
Crucible material	PG
Insert material	Refractory metal / PG
Filament type	Double wire Ta filament
Thermocouple	C type
Typical operating temperature	1100°C
Temperature stability	± 0.1°C
Power consumption	300W / 300W
Power connector	RI5 (Ø5)
Thermocouple connector	Omega type

Ordering information

Model	Reference	Crucible reference
MS 240	R 235 014 51 N	R 235 005 50 J



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Length 8m / Fully bakeable to 200°C	2	R 252 270 40 D
3	Power supply	One channel 1.5kW DC Rack mountable 19" wide / 1U high Power cord included	2	R 461 225 02 M
4	Command cable	Length 2,5 m	2	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / rack mountable / power cord included	2	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	2	R 252 304 30 N
7	Communication strap	To PID controller	1	R 252 297 60 K
8	Communication assembly		-	Consult Riber

MEDIUM TEMPERATURE MATERIALS

Medium temperature effusion cell

- **More than 10 000 effusion cells worldwide**
- **Provides pure, stable and reproducible beam fluxes**
- **Uniformities better than ±1 %**
- **Rugged and reliable design**
- **Cost effective**

Riber single filament cells are the most commonly used worldwide. They are used for a wide variety of elements. The oven radiates heat uniformly along the crucible length. Double filament cells allows the temperature to be varied over the length of crucible, in order to accentuate either a "hot lip" or "cold lip" type behavior. They prevent condensation at the crucible mouth by heating this zone to a higher temperature like for Gallium and Indium materials.

Riber strongly recommends the use of a bottom filament design with the use of Aluminum. Indeed, Aluminum tends to wet the PBN crucible and rises along the crucible wall creating a risk of overflow. Filament located at the bottom has a steeper temperature gradient between the bottom and the mouth of the cell contrary to all other filament design. In addition to the oven design a specific crucible enhances the cold lip effect.

Dual, single and bottom filament design

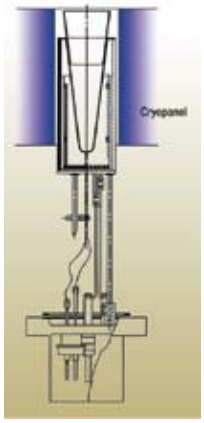
Product guide

Cell model
X : 125 or 135

T/C type : C : W/Re

ABN X | Y | Z

Filament design : SF : single filament
DF : dual filament
CN : cold neck



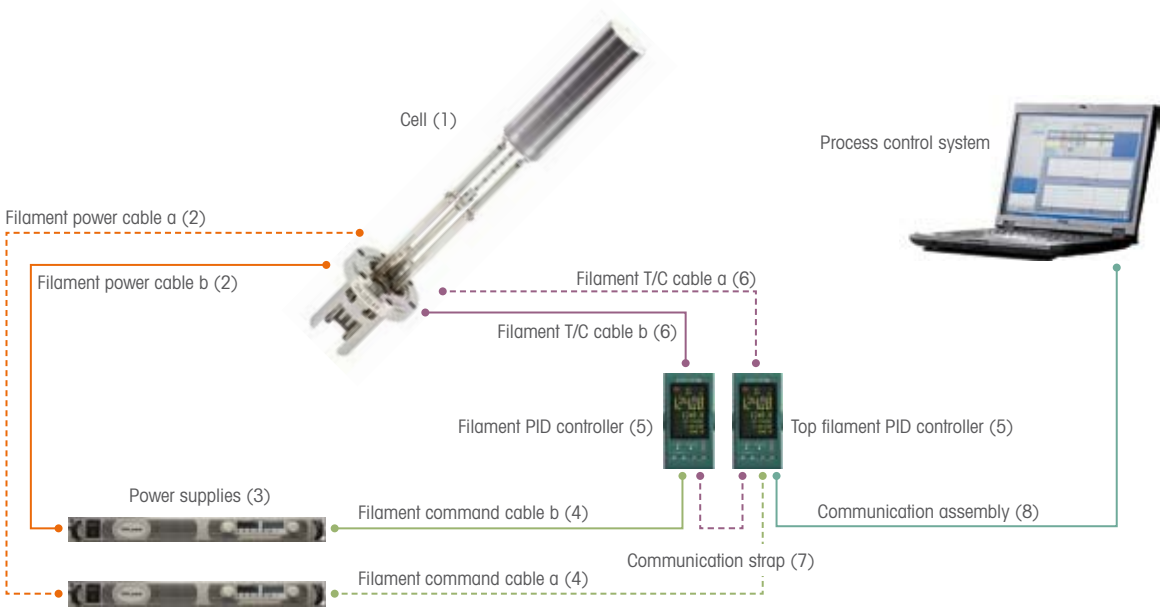
Crucible design
for Aluminum cell

Specifications

	ABN 125 SF C	ABN 135 SF C	ABN 135 DF C	ABN 135 CN C
Source nominal capacity	25 cc	35 cc	35 cc	35 cc
Uniformities	<± 1%			
Crucible shape	Cylindrical			
Crucible taper	1°			
Crucible material	PBN			
Filament heater	One flat Tantalum filament		Two flat Tantalum filament	One flat Tantalum filament
T/C type	One C type		Two C type	One C type
Typical operating temperature	750 – 1200°C			
Maximum outgassing temperature	1300°C		Bottom filament 1400°C Top filament 1300°C	1300°C
Power supply	One power supply / One PID controller		Two power supplies / Two PID controller	One power supply / One PID controller

Ordering information

Model	Reference	Crucible reference
ABN 125 SF C	R 240 731 60 L	R 302 776 40 L
ABN 135 SF C	R 240 731 70 X	R 302 750 00 S
ABN 135 DF C	R 240 732 11 S	R 302 750 00 S
ABN 135 CN C	R 240 732 00 S	R 240 888 60 B



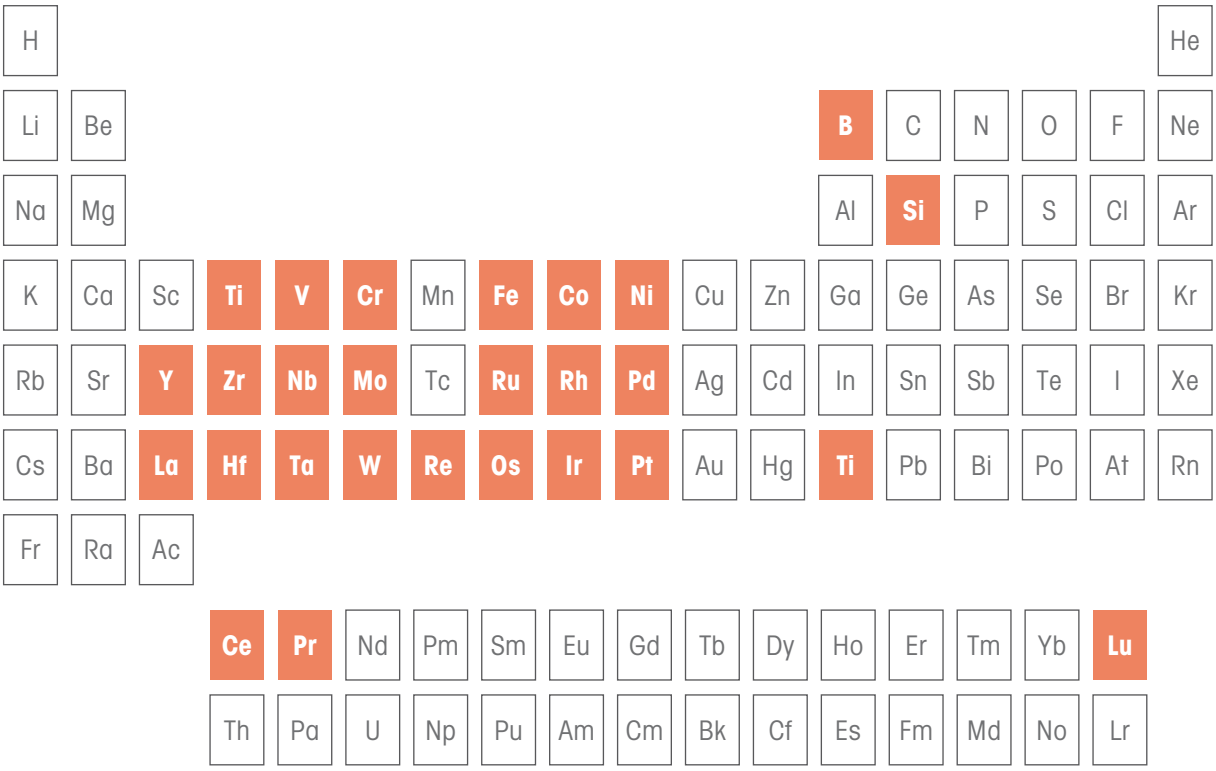
---------- : for dual filament sources

Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	-	R 252 270 40 D
3	Power supply	One channel (40V - 38A) DC / Rack mountable 19'' wide / 1U high / Power cord included	-	R 461 225 05 R
4	Command cable	Length 5 m	-	R 252 323 30 D
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / power cord included	-	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	-	R 252 304 30 N
7	Communication strap	To PID controller	-	R 252 297 60 K
8	Communication assembly		-	Consult Riber

HIGH TEMPERATURE MATERIALS

High temperature source – HT technology



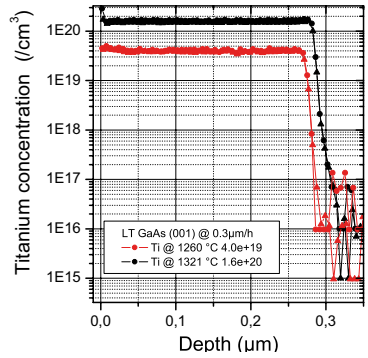
HIGH TEMPERATURE MATERIALS

High temperature source HT technology

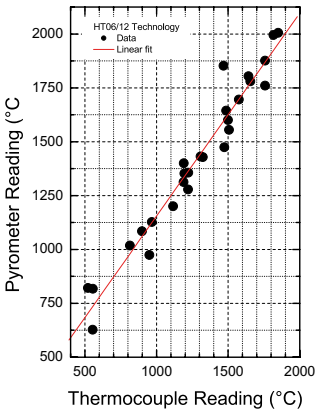
- **Clean, reliable operation up to 2000°C**
- **Self supporting filament for clean operation**
- **Alternative to expensive E-beam gun equipment**
- **Large variety of crucibles and liners available**

Riber high temperature effusion source provides thermal evaporation of charge materials to temperatures up to 2000°C. Hot zone is constructed exclusively with refractory materials ensuring clean operation under UHV environment. High working temperatures are achieved through the use of a robust resistively heated filament. The filament is self supported to avoid reactions with insulating material. Insulating ceramics are restricted to cooler regions of the source, preventing outgassing during operation. Crucibles and liners are made off refractory metals and ceramic materials. The appropriate choice will vary with the applications and materials used. Models integrating a water cooling circuit surrounding the source as well as a shutter are available.

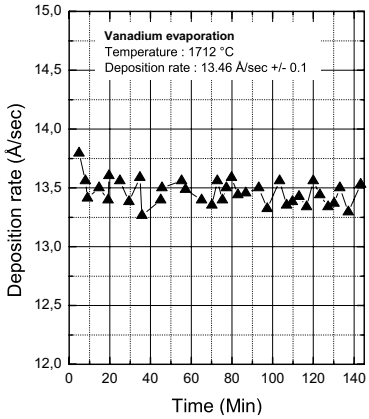
Results



SIMS profile of low temperature GaAs(001) doped with Titanium. Titanium doping is performed at two temperatures 1321°C and 1260°C. Titanium deposition rate reaches 2.510^{-2} Å/sec and 6.810^{-3} Å/sec respectively. Stable and reproducible Titanium flux profile is obtained run after run.

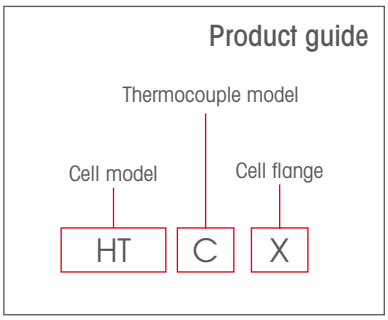


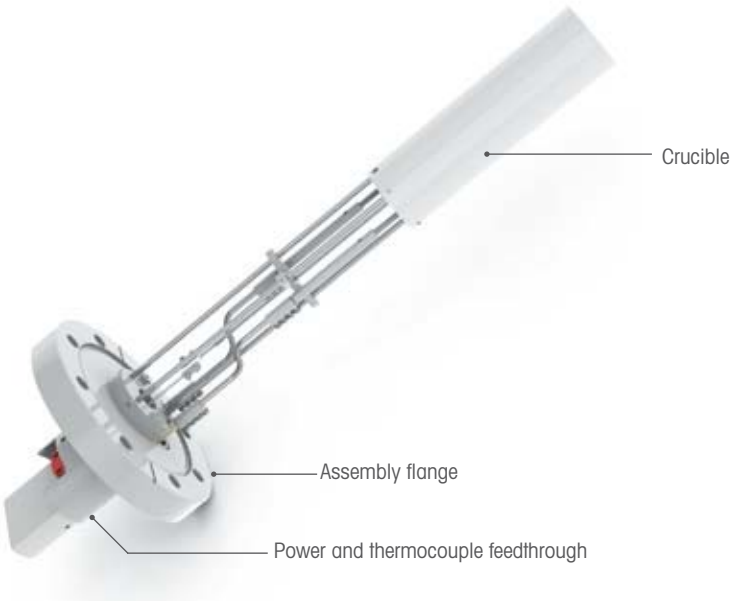
Riber high temperature cell provides clean UHV operation up to 2000°C.
Use of insulating ceramics are restricted to the cooler part of the source.



Vanadium evaporation at 1712°C shows stable flux at 13.5Å/sec
Courtesy of K.Durmenil, Lab. Phys. Mat. Unibv. H. Poincarré Nancy

Product guide

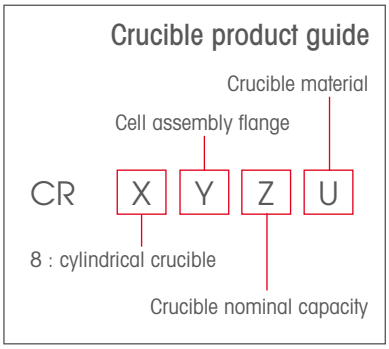




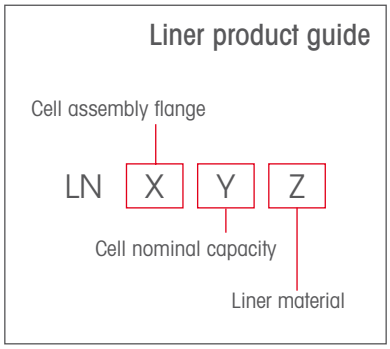
Specifications

	HT C X
Source capacity	6 cc or 12 cc
Crucible / Liner material	Ta or PBN or PG
Filament type	Single tungsten filament
Thermocouple type	C type
Typical operating temperature	700 – 1800°C
Maximum outgassing temperature	2000°C
Power supply	One power supply / One temperature controller

Crucible product guide



Liner product guide

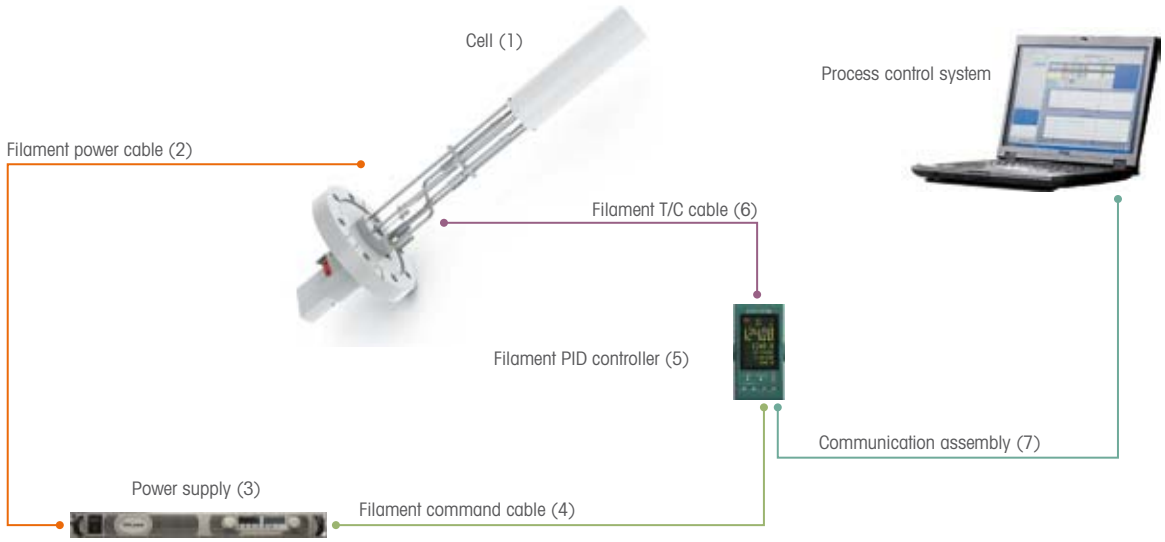


Ordering information

Model	Reference
HT C 40	R 235 010 90 W
HT C 63	R 235 012 80 C

Equipment	Crucible / Liner model	Reference
Crucible	CR 835006 Ta	R 330 018 30 M
Crucible	CR 835006 PBN	R 330 018 10 R
Crucible	CR 835012 Ta	R 330 003 90 X
Crucible	CR 835012 W	R 330 091 70 R
Crucible	CR 835012 PBN	R 330 018 20 B
Liner	LN 35006 Al2O3	R 330 018 50 J
Liner	LN 35006 PBN	R 330 018 90 C
Liner	LN 35006 PG	R 330 018 70 F
Liner	LN 35012 Al2O3	R 330 018 60 V
Liner	LN 35012 PBN	R 330 019 00 N
Liner	LN 35012 PG	R 330 018 80 S

Because of the large variety of applications, Riber cannot garantee the use of any crucible or liner material to be used for a specific evaporant. We will report, however, what others have tried and will try to warn you of any known incompatibilities between the evaporant and crucible or liner.



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	1	R 252 270 40 D
3	Power supply	One channel 1.5 kW DC / Rack mountable 19'' wide / 1U high / Power cord included	1	R 461 225 02 M
4	Command cable	Length 2,5 m	1	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / power cord included	1	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	1	R 252 304 30 N
7	Communication assembly		-	Consult Riber

DOPANT SOURCES

Effusion source for dopant material

Solid Carbon source

CBr4 dopant source

DOPANT SOURCES

Dopant source

- **Small capacity – uniform beam distribution**
- **Extremely efficient, reliable and reproducible source**
- **Provides pure, stable and reproducible beam fluxes**
- **Dopant uniformities better than ± 1 %**

Riber cells for doping applications are designed to obtain both highly stable beams and rapid variations in beam flux over several orders of magnitude. These cells generally employ crucible to enable the use of lower temperatures for the highest dopant levels and to ensure excellent doping uniformities.

Product guide

Dopant cell

Cell model

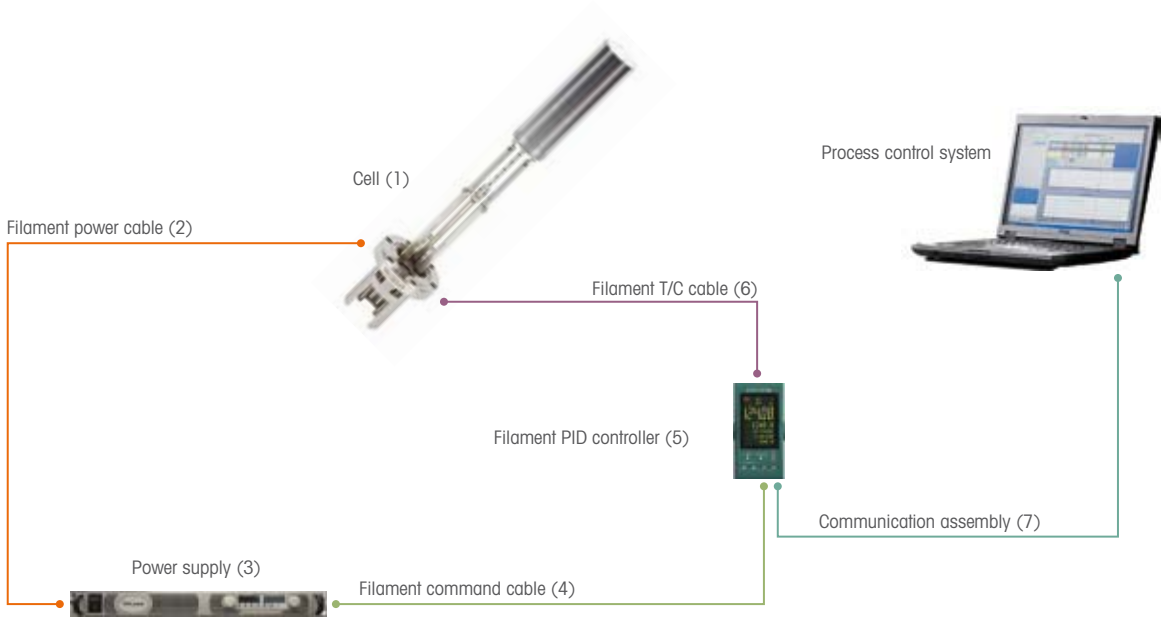
ABN 135 | DC

Specifications

	ABN 135 DC
Source nominal capacity	12 cc
Uniformities	<± 1%
Crucible shape	Cylindrical
Crucible material	PBN
Crucible taper	1°
Filament type	Single tantalum filament
Thermocouple type	One C type
Typical operating temperature	600 - 1250°C
Maximum outgassing temperature	1400°C
Power supply	One power supply / One temperature controller

Ordering information

Model	Reference	Crucible reference
ABN 135 DC	R 240 731 80 H	R 304 492 60 E



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	1	R 252 270 40 D
3	Power supply	One channel 1.5 kW DC / Rack mountable 19'' wide / 1U high / Power cord included	1	R 461 225 05 R
4	Command cable	Length 2,5 m	1	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / power cord included	1	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	1	R 252 304 30 N
7	Communication assembly		-	Consult Riber

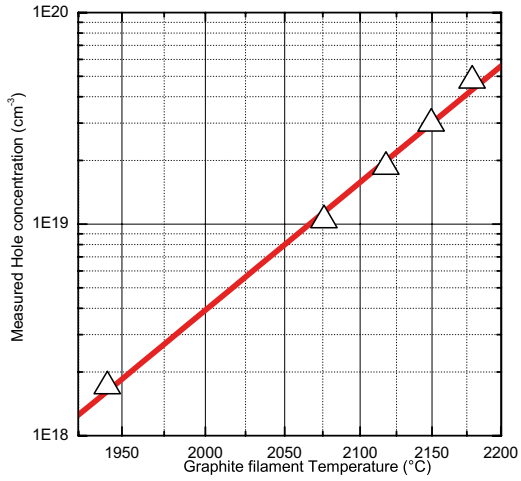
DOPANT SOURCES

Solid carbon source

- **Ease of operation**
- **High doping level**
- **Temperature operation range 2000 - 2300 °C**
- **Rapid flux variation**
- **Excellent uniformities**

Riber carbon sublimation doping cell is used for carbon doping. Flux of carbon is generated by sublimating a high purity Pyrolithic graphite filament. The filament is heated by direct flow of high intensity current. Region surrounding the filament is made of the same PG material to garantee the extreme purity of the carbon flux. During operation filament is heated to the range of 2000 - 2300 °C. The low thermal mass of the filament allows to quickly change doping levels. Excellent uniformities over 2" and 3" substrates are reached.

Results



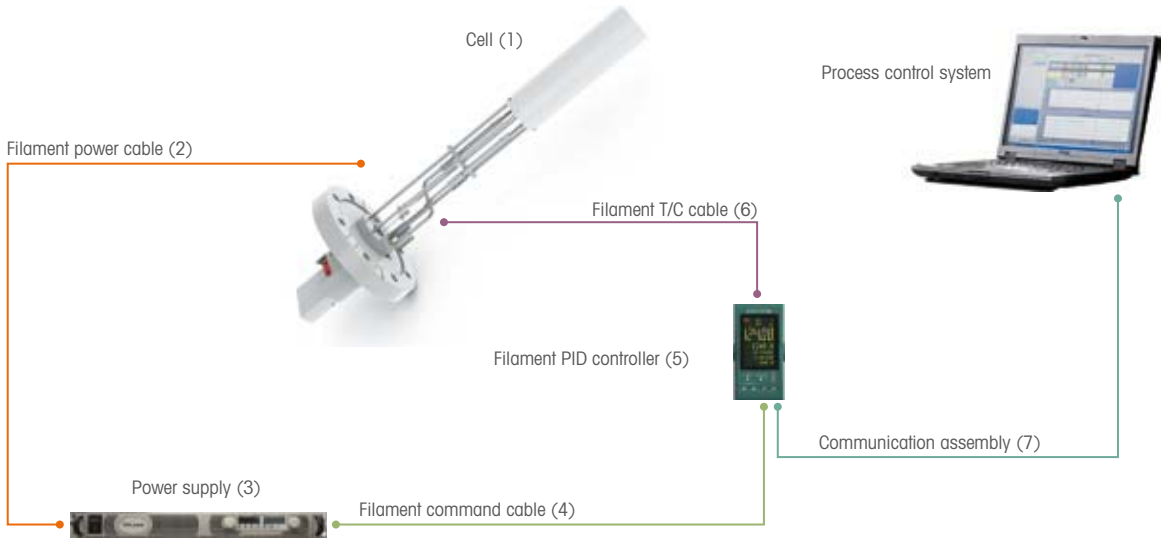
Hole concentration at 300 k in C doped GaAs as a function of the carbon filament has been recorded hole concentration varies from 10^{18} to 10^{20} cm^{-3}.

Specifications

	Solid Carbon Source
Filament type	High purity carbon
Maximum temperature	2300 °C
Typical operating temperature	2100 °C
Thermocouple	C-type
Power supply	One power supply / One temperature controller

Ordering information

Model	Reference
Solid Carbon Source	R 235 051 90 C



Additional accessories

Item	Equipment	Description	Qty per cell	Reference
2	Power cable	Fully bakeable to 200°C / Length 8 m	1	R 252 270 40 D
3	Power supply	One channel 1.5 kW DC / Rack mountable 19'' wide / 1U high / Power cord included	1	R 461 225 02 M
4	Command cable	Length 2,5 m	1	R 252 313 80 W
5	PID temperature controller	Eurotherm 3508 PID controller / Rack mountable / power cord included	1	R 461 110 00 K
6	T/C cable, W-Re	Length 11 m	1	R 252 304 30 N
7	Communication assembly		-	Consult Riber

DOPANT SOURCES

CBr4 Dopant Source

- Injector see page 20
- Gas line module see page 18

OTHER SOURCE

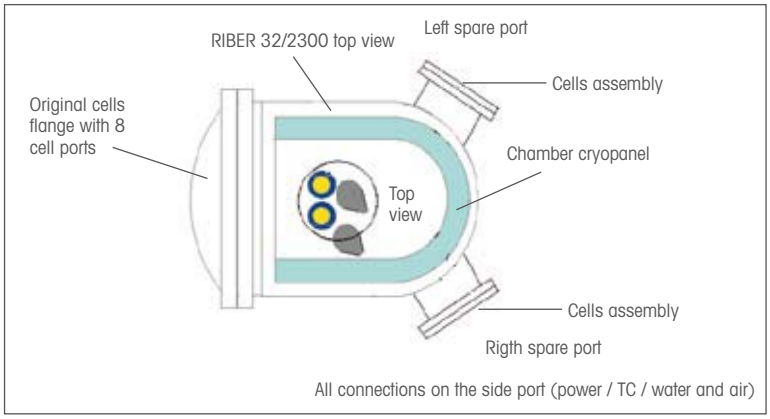
Extra sources on lateral flange

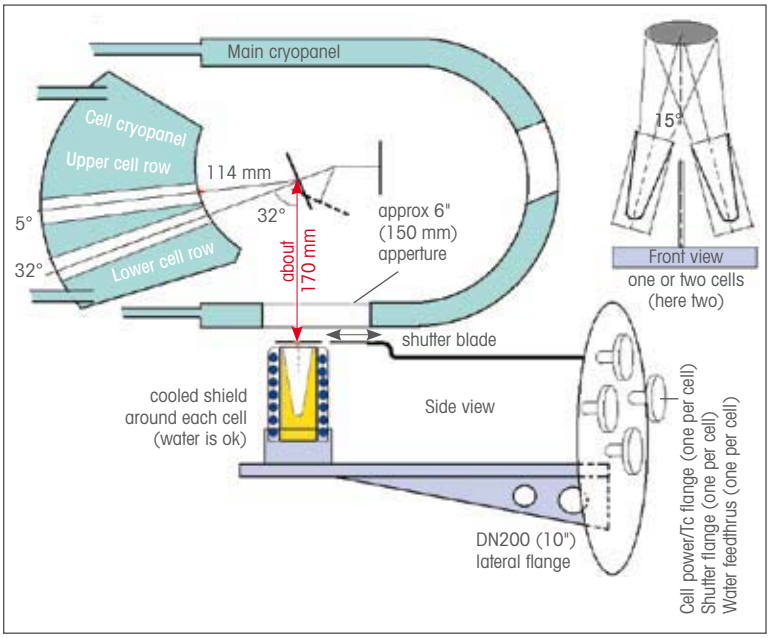
OTHER SOURCE

Extra sources on lateral flange

- **Boost your system capability**
- **Add system uptime with more material capacity**
- **Add one or two more cells**
- **Easy to install and maintain**

Riber provides a solution to increase your system capability by adding one or two extra cells. This cell can be used for any materials and compounds. One or two cells are assembled onto one CF 200 flange. Each cell has its individual linear shutter and water shroud. Assembly is mounted on the CF 200 lateral flange, right or left side of the MBE 32 growth chamber.





Ordering information : Please contact us

ACCESSORIES

MBE process control software - CRYSTAL

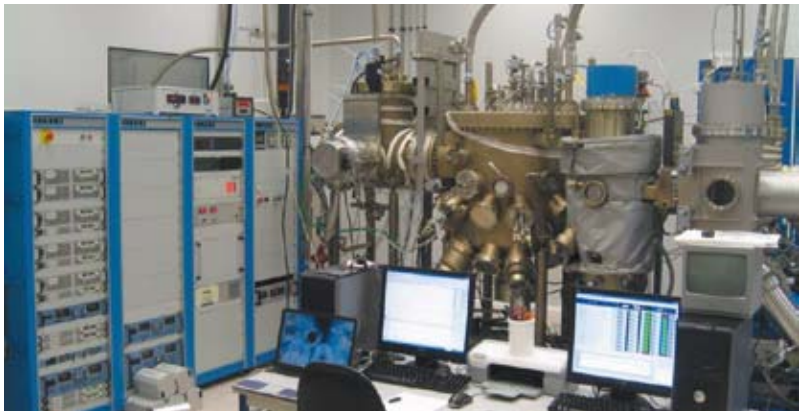
Automatic valve positioner

Substrate holder

ACCESSORIES

MBE process control software - CRYSTAL

- **More than 150 units in the field**
- **Real time control of the entire MBE process**
- **Easy to implement, operate and upgrade**
- **User friendly graphical interface**
- **Windows based operating system**



Riber CRYSTAL is a powerful and complete process control solution especially designed for the real-time supervision of MBE, gas-source MBE, and chemical beam epitaxy (CBE) research and production machines. This graphical and interactive automation tool, based upon industry-standard operating system and PCs, provides continuous precise information during the entire epitaxy process, from equipment configuration to growth data acquisition, storage and processing.

Riber CRYSTAL process control software consists of seven modules :
1."CRYSTAL Set-up" is intended to assist the operator in installing the application.
2."CRYSTAL Preferences" provides the edition tools to customise the process control software parameters: i.e. default directories, default parameters, supervision mode, etc.
3."CRYSTAL Toolbox" enables describing the particular material configuration of the MBE machine to be supervised (list of equipment, PID regulators and controllers, communication ports and interconnecting wiring, etc.).
4."CRYSTAL Schedule" enables editing recipes adapted to the configuration of the machine.
5."CRYSTAL Batch" enables editing production batches adapted to the configuration of the MBE machine.
6."CRYSTAL Eyes" is an interactive graphical user interface and enables operators to supervise any MBE machine in operation.
7."CRYSTAL Analyser" enables extracting information from record sessions and producing reports that can be printed or exported to spreadsheet programs.

CRYSTAL control software enables :

Control (setpoint, PID, ramp, etc.) over :
- Effusion and cracker cells
- Flux valve controllers
- Shutters
- Valved gas injectors
- Shut-off valves, MFC and pressure controllers
- Platen manipulator
- Flux gauge
- Wafer handling system.

Monitoring of :
- PID regulation rack (wide PID library)
- Pressure and flux gauges
- In-situ instrumentation
- Power supply safety interface.

Data management of :
- MBE machine & installed components
- Unlimited epi growth recipe editor
- Ramp editor
- Growth process to report editor.

ACCESSORIES

Automatic valve positioner

Riber valve position controller equipment, the NVC 6000, provides a real time control of the absolute position of the valve by brushless motor and closed loop movement control with speed feedback. Riber NVC 6000 is compatible with Crystal MBE process control software. Riber NVC 6000 offers the possibility to control to up to three valves on the same equipment.

Specifications

	NVC 6000
Valve control	Up to three valve
Installation	19'' / 2U rack mountable
Main supply	208 V / 240 V AC 47/63 Hz
Front panel	LCD digital display
Internal architecture	RS 232/422/485 PC interface
	Supplied with up to 3 brushless motor units and cables
	Torque monitoring to close the valve. Automatic finding of the home positions
	Microprocessed unit with internal memory storage, immediate access to 5 programmable positions
	Safety interlock input

Ordering information

Equipement	Reference
NVC 6000 – 1 channel	R 270 522 00 Y
Additional channel	R 270 521 90 M

ACCESSORIES

Substrate Holders - Molybloc

Molybloc without thermocouple Well

Molybloc with thermocouple well

Molybloc quarter of 2" wafer

Ordering information

Wafer size	Molybloc diameter	Molybloc design		Reference
Whole 2'' wafer	2''	Molybloc with thermocouple (T/C) well	MOB 2 M	R 240 124 30 A
	2''	Molybloc without T/C well / Indium –free	MOB 2 IF	R 240 269 91 C
	3''	Molybloc without T/C well / Indium-free	MOB 2/3 IF	R 240 356 70 L
Whole 3'' wafer	3''	Molybloc with T/C well	MOB 3 M	R 240 181 00 B
	3''	Molybloc without T/C well / Indium –free	MOB 3 IF	R 240 269 81 S
Quarter of 2'' wafer	2''	Molybloc without T/C well / Indium- free	MOB 2 IF 2''1/4	R 240 705 80 G
	3''	Molybloc without T/C well / Indium- free	MOB 3 IF 2''1/4	R 240 053 20 T
Quarter of 3'' wafer	3''	Molybloc without T/C well / Indium-free	MOB 3 IF 3''1/4	R 241 147 60 D

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From MBE components and research systems to high volume production systems Riber is a world leading supplier of products and services to the compound semiconductor industry.

Riber sales and service network :

For more information please contact your local sales representative

RIBER

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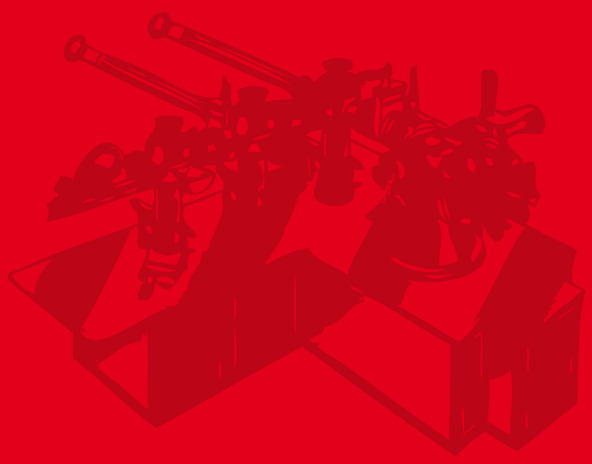

RIBER

CELLS & SOURCES

Product Guide for MBE 32 / 2300 series

SPECIALITY SOURCES : RF Plasma Source for N2 / O2 / H2 / Solid Materials / Valved RF Plasma Source for N2 and other gases / Ammonia Module / CBr4 Module / Gas injectors / Mercury source / Source for alcaline materials **LOW TEMPERATURE MATERIALS :** Low temperature source – DZ MM series / Valved cracker cell for Arsenic / Valved cracker cell for Phosphorus / Valved corrosive source for Antimony, Magnesium, Tellurium / Low temperature effusion sources **MEDIUM TEMPERATURE MATERIALS :** MS source for Gallium and Indium / Medium temperature effusion sources **HIGH TEMPERATURE MATERIALS :** High temperature source – HT Technology **DOPANT SOURCES :** Dopant source / Carbon dopant source / Cbr4 dopant source **OTHER SOURCES :** Extra sources on lateral flange **ACCESSORIES :** MBE process control software - CRYSTAL / Automatic valve positioner / Substrate holder - molyblocs